

USER MANUAL for

MultiCon

device type: **CMC-99 X/X/X-1-X-0XX**

firmware version: 1.03 or higher



Read the user's manual carefully before starting to use the unit or software.
Producer reserves the right to implement changes without prior notice.

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Explanation of symbols used in the manual:



- This symbol denotes especially important guidelines concerning the installation and operation of the device. Not complying with the guidelines denoted by this symbol may cause an accident, damage or equipment destruction.

IF THE DEVICE IS NOT USED ACCORDING TO THE MANUAL THE USER IS RESPONSIBLE FOR POSSIBLE DAMAGES.



- This symbol denotes especially important characteristics of the unit.
Read any information regarding this symbol carefully

1. BASIC REQUIREMENTS AND USER SAFETY



- **The manufacturer is not responsible for any damages caused by inappropriate installation, not maintaining the proper technical condition and using the unit against its destination.**
- Installation should be conducted by qualified personnel . During installation all available safety requirements should be considered. The fitter is responsible for executing the installation according to this manual, local safety and EMC regulations.
- The unit must be properly set-up, according to the application. Incorrect configuration can cause defective operation, which can lead to unit damage or an accident.
- **If in the case of a defect of unit operation there is a risk of a serious threat to the safety of people or property additional, independent systems and solutions to prevent such a threat must be used.**
- **The unit uses dangerous voltage that can cause a lethal accident. The unit must be switched off and disconnected from the power supply prior to starting installation of troubleshooting (in the case of malfunction).**
- Neighbouring and mating equipment must meet the requirements of appropriate standards and regulations concerning safety and be equipped with adequate anti-overvoltage and anti-interference filters.



- **Do not attempt to disassemble, repair or modify the unit yourself. The unit has no user serviceable parts. Units, in which a defect was stated must be disconnected and submitted for repairs at an authorized service centre.**



- In order to minimize fire or electric shock hazard, the unit must be protected against atmospheric precipitation and excessive humidity.
- Do not use the unit in areas threatened with excessive shocks, vibrations, dust, humidity, corrosive gasses and oils.
- Do not use the unit in explosion hazard areas.
- Do not use the unit in areas with significant temperature variations, exposed to condensation or icing.
- Do not use the unit in areas exposed to direct sunlight.
- Make sure that the ambient temperature (e.g. inside the control box) does not exceed the recommended values. In such cases forced cooling of the unit must be considered (e.g. by using a ventilator).



The unit is designed for operation in an industrial environment and must not be used in a household environment or similar.

1.1. THE USE OF TOUCH-SCREEN

It is prohibited to use pointers with sharp edges (like knives, scissors, needles, wires, nails, bolts etc.) while work with touch-screen. It is strongly recommended to use special stylus made of plastic or other soft material with smooth ends (for example stylus delivered with the device). The display of **CMC-99** should be also protected against aggressive substances and extremely high and low temperatures that can cause damages.

2. GENERAL CHARACTERISTICS

MultiCon CMC-99 is a sophisticated multichannel unit which allows simultaneous measurement, visualisation and control of numerous channels. It is ideal for applications where some physical quantities represent state of an object and control of this state is based on concurrent parameters. This device can operate autonomously or with cooperation with external measurement devices and actuators. Essential features of **CMC-99** are listed and shortly described below.

• Advanced processing unit and system based on LINUX

High computation efficiency of **CMC-99** processor allows to run the device under control of LINUX operating system. Such solution makes firmware flexible and gives the possibility of simultaneous operation of many processes (like: measurement, communication, visualisation). Use of LINUX also makes software independent on installed hardware.

- **Colour TFT display with Touch-panel**

MultiCon displays all data and dialogues on 3,5" 320x240 pixels, colour TFT screen. Full control of the device is realised using build in touch-panel what makes operation with **CMC-99** easy and intuitive.

- **Hardware flexibility and big variety of possible configurations**

CMC-99 is designed as modular device consisting of a **base** and optional **input and output modules**. The **base** contains: main processor, display with touch-screen, Switch Mode Power Supply (in two versions: 24V and 85-260V) and basic communication interfaces (USB and RS485). All other modules are optional and can be installed inside the device according to customer's order. There are three slots designed for installation of measurement and output modules and one (fourth) slot for advanced communication module (additional USB Host, 2x RS-485/RS-232 and Ethernet). Basic measurement modules are: 4/8/16x Voltage/Current input module, 4x RTD input module and 4/8x TC input module, 8/16x Optoisolated digital input. As output modules can be installed: 8/16x SSR driver module, 4/8x Relay modules or 2/4x Passive current output module.

- **Freedom of data sources, presentation modes and controlling methods**

Multi level structure of **CMC-99** firmware allows user for free selection of presented data sources, presentation modes and controlling methods. **CMC-99** displays values of virtual **logical channels** which can be fed with measurement data from build in physical channels or measurement data from remote channels (other devices connected to the **CMC-99** by RS-485 interface), or output states and quantities (looped back results of controlling processes), generate profiles/timers by user or also mathematical combination of one or more other **logical channels**. All of them can be freely named and described by user, and presented in many forms: as numerical values, vertical and horizontal charts, vertical and horizontal bars and as needles. Every **logical channel** (visualised or not) can be used as an input data of one or more controlling process. **CMC-99** implements many different controlling methods: above and below defined level, inside and outside of defined range (both with programmable hysteresis and delay of relay on and off) and PID. Controlling processes can drive build in physical output or virtual outputs which can be used as input of **logical channels**.

3. TECHNICAL DATA

Power supply voltage (depending on version)	85... 230 ...260V AC/DC; 50 ÷ 60 Hz
External Fuse (required)	or 19... 24 ...50V DC; 16V... 24 ...35V AC
Power consumption	T - type, max. 2 A typically 15 VA; max. 20 VA
Display	3,5", TFT colour graphic display, 320 x 240 points, with LED backlight
Sensor power supply output	24V DC ± 5% / max. 200 mA,
Basic communication interfaces	RS 485, 8N1/2, Modbus RTU, 1200 bit/s ÷ 115200 bit/s USB Host port, USB Device port

Digital input	1 input 0/15..24V DC, galvanic insulation power consumption: 7,5 mA / 24V, insulation: 1min @ 500V DC.
Optional communication module*	Second USB Host port 2x Serial RS-485/RS-232 Ethernet 10M RJ-45
Optional input modules*	4/8/16x Voltage (0÷10V) / Current (0÷20mA)** 4x RTD (PT100, PT500, PT1000)** 4/8x TC (J, K, S, T, N, R, B, E)** 8/16x Digital input**
Optional output modules*	4x Relay 5A/250V (cos φ = 1)** 8x Relay 1A/250V (cos φ = 1)** 8/16x SSR driver (10÷15V, up to 100mA per output)** 2/4x IO Passive current output (4÷20mA)**
Protection level	
USB interface on rear panel	IP 65 (from front, after using waterproof frame) IP 42 (from front, with transparent door) IP 40 (from front, standard) IP 20 (housing and connection clips)
USB interface from front	IP 42 (from front, with transparent door) IP 40 (from front, standard) IP 20 (housing and connection clips)
Housing type	panel
Housing material	NORYL - GFN2S E1
Housing dimensions	96 x 96 x 100 mm
Mounting hole	90,5 x 90,5 mm
Assembly depth	102 mm
Panel thickness	max. 5 mm
Operating temperature	0°C to +50°C
Storage temperature	-10°C to +70°C
Humidity	5 to 90% no condensation
Altitude	up to 2000 meters above sea level
Screws tightening max. torque	0,5 Nm
Max. connection leads diameter	2,5 mm ²
Safety requirements	according to: PN-EN 61010-1 installation category: II pollution degree: 2 voltage in relation to ground: 300V AC insulation resistance: >20M Ω insulation strength between power supply and input/output terminal: 1min. @ 2300V (see Fig. 4.1)
EMC	PN-EN 61326-1

* check the current list of measurement modules at www.simex.com.pl

** see the full specification in the appendix

4. DEVICE INSTALLATION

The unit has been designed and manufactured in a way assuring a high level of user safety and resistance to interference occurring in a typical industrial environment. In order to take full advantage of these characteristics installation of the unit must be conducted correctly and according to the local regulations.



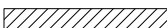
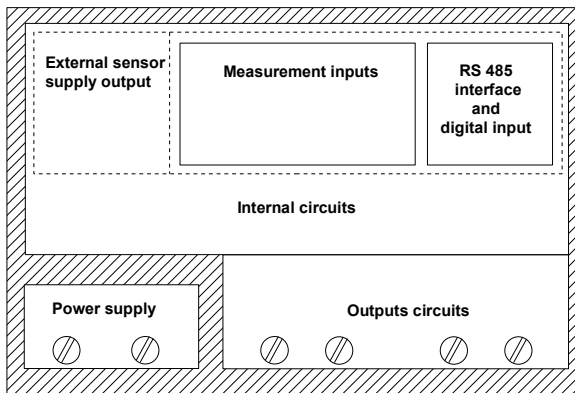
- Read the basic safety requirements on page 3 prior to starting the installation.
- Ensure that the power supply network voltage corresponds to the nominal voltage stated on the unit's identification label.
- The load must correspond to the requirements listed in the technical data.
- All installation works must be conducted with a disconnected power supply.
- Protecting the power supply clamps against unauthorized persons must be taken into consideration.



This is a class A unit. In housing or a similar area it can cause radio frequency interference. In such cases the user can be requested to use appropriate preventive measures.



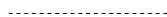
Carefully check that the insulation used with the unit (Fig. 4.1) meets the expectations and if necessary use appropriate measures of overvoltage protection. Additionally, assure the maintenance of appropriate installation air and surface insulation gaps.



Insulation strength 1min @ 2300V AC



Insulation strength 1min @ 500V AC



No insulation

Fig. 4.1. Schematic diagram showing the insulation between individual circuits of the unit.

4.1. UNPACKING

After removing the unit from the protective packaging, check for transportation damage. Any transportation damage must be immediately reported to the carrier. Also, write down the unit serial number on the housing and report the damage to the manufacturer.

Attached with the unit please find:

- assembly brackets - 2 pieces,
- warranty,
- user's manual for **CMC-99** unit (device)

4.2. ASSEMBLY



- The unit is designed for mounting indoor inside housings (control panel, switchboard) assuring appropriate protection against electric impulse waves. Metal housing must be connected to the grounding in a way complying with the governing regulations.
- Disconnect the power supply prior to starting assembly.
- Check the correctness of the performed connections prior to switching the unit on.

In order to assembly the unit, a 90,5 x 90,5 mm mounting hole (Fig. 4.2) must be prepared. The thickness of the material of which the panel is made must not exceed 5mm. When preparing the mounting hole take the grooves for catches located on both sides of the housing into consideration (Fig. 4.2). Place the unit in the mounting hole inserting it from the front side of the panel, and then fix it using the brackets (Fig. 4.3). The minimum distances between assembly holes' axes - due to the thermal and mechanical conditions of operation - are 115 mm x 115 mm (Fig. 4.5).

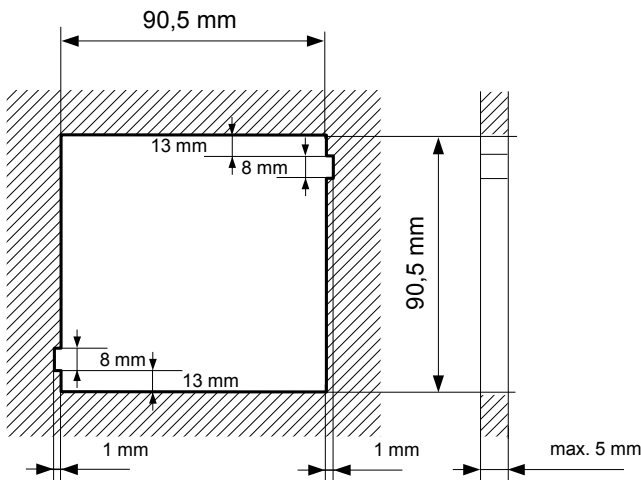


Fig. 4.2. Mounting hole dimensions

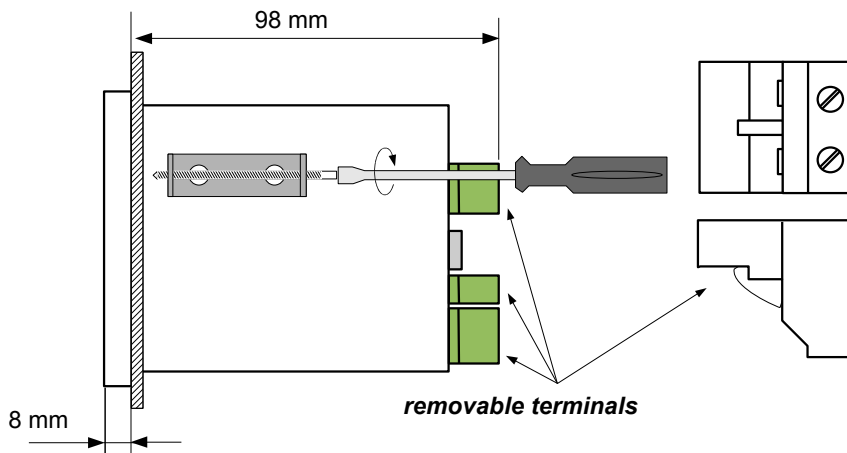
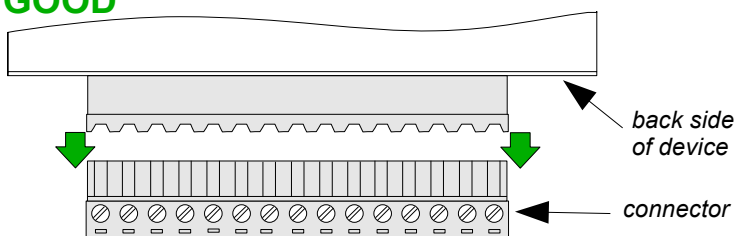


Fig. 4.3. Installing of brackets

GOOD



WRONG

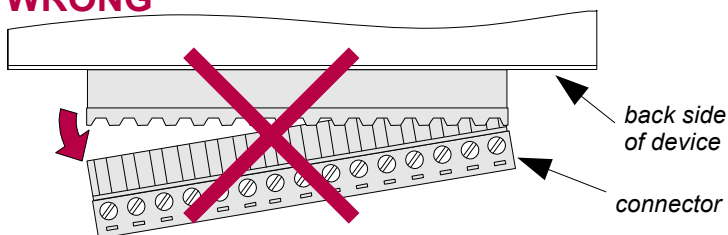


Fig. 4.4. Connectors removing method

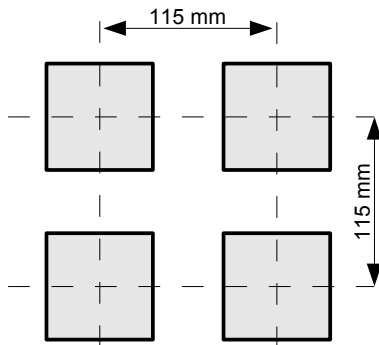


Fig. 4.5. Minimum distances when assembly of a number of units

4.3. CONNECTION METHOD

Caution



- Installation should be conducted by qualified personnel. During installation all available safety requirements should be considered. The fitter is responsible for executing the installation according to this manual, local safety and EMC regulations.
- The unit is not equipped with an internal fuse or power supply circuit breaker. Because of this an external time-delay cut-out fuse with minimal possible nominal current value must be used (recommended bipolar, max. 2A) and a power supply circuit-breaker located near the unit. In the case of using a monopolar fuse it must be mounted on the phase cable (L).
- The power supply network cable diameter must be selected in such a way that in the case of a short circuit of the cable from the side of the unit the cable shall be protected against destruction with an electrical installation fuse.
- Wiring must meet appropriate standards and local regulations and laws.
- In order to secure against accidental short circuit the connection cables must be terminated with appropriate insulated cable tips.
- Tighten the clamping screws. The recommended tightening torque is 0.5 Nm. Loose screws can cause fire or defective operation. Over tightening can lead to damaging the connections inside the units and breaking the thread.
- In the case of the unit being fitted with separable clamps they should be inserted into appropriate connectors in the unit, even if they are not used for any connections.
- **Unused clamps (marked as n.c.) must not be used for connecting any connecting cables (e.g. as bridges), because this can cause damage to the equipment or electric shock.**



- If the unit is equipped with housing, covers and sealing packing, protecting against water intrusion, pay special attention to their correct tightening or clamping. In the case of any doubt consider using additional preventive measures (covers, roofing, seals, etc.). Carelessly executed assembly can increase the risk of electric shock.

- After the installation is completed do not touch the unit's connections when it is switched on, because it carries the risk of electrical shock.

Due to possible significant interference in industrial installations appropriate measures assuring correct operation of the unit must be applied. To avoid the unit of improper indications keep recommendations listed below.

- Avoid common (parallel) leading of signal cables and transmission cables together with power supply cables and cables controlling induction loads (e.g. contactors). Such cables should cross at a right angle.
- Contactor coils and induction loads should be equipped with anti-interference protection systems, e.g. RC-type.
- Use of screened signal cables is recommended. Signal cable screens should be connected to the earthing only at one of the ends of the screened cable.
- In the case of magnetically induced interference the use of twisted couples of signal cables (so-called "spirals") is recommended. The spiral (best if shielded) must be used with RS-485 serial transmission connections.
- In the case of interference from the power supply side the use of appropriate anti-interference filters is recommended. Bear in mind that the connection between the filter and the unit should be as short as possible and the metal housing of the filter must be connected to the earthing with largest possible surface. The cables connected to the filter output must not run in parallel with cables with interference (e.g. circuits controlling relays or contactors).

Connections of power supply voltage and measurement signals are executed using the screw connections on the back of the unit's housing.

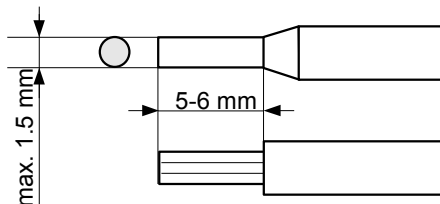


Fig. 4.6. Method of cable insulation replacing and cable terminals dimensions



All connections must be made while power supply is disconnected !

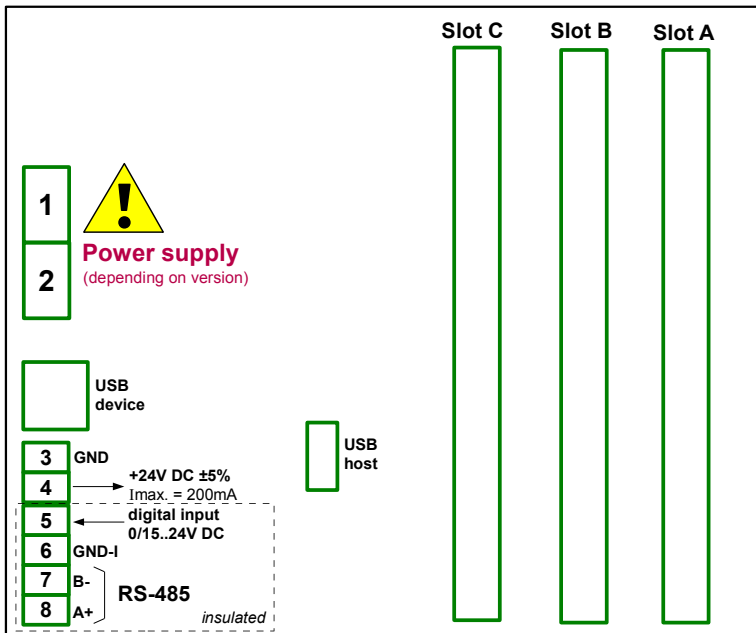


Fig. 4.7. Terminals description



Only most left terminals (Power supply, USB Device port, Sensor supply output, Digital input and RS-485) are standard. Advanced communication module (additional serial, USB and Ethernet interfaces), and three input/output modules (slot A, slot B, slot C) showed in Fig. 4.7 depends on customer's order. According to the order these terminals can look differently or be not present. Terminals and connections of available modules are shown on Fig. 4.9-4.12.

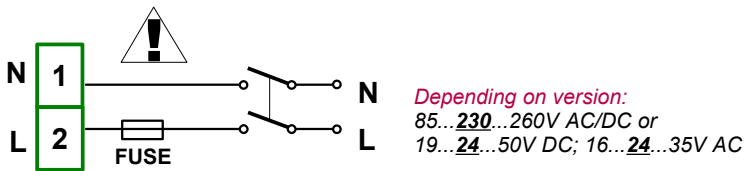


Fig. 4.8. Connection of power supply

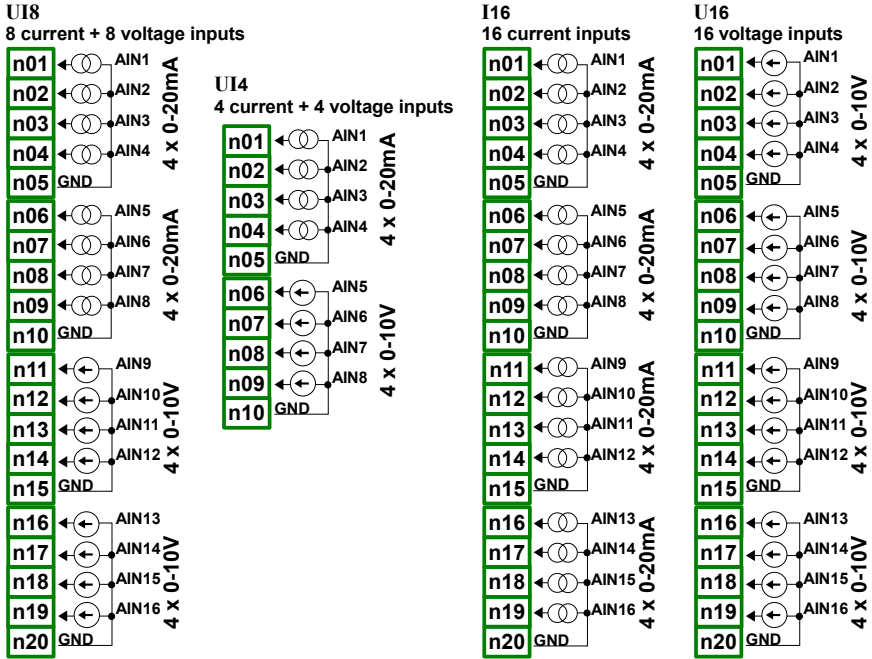


Fig. 4.9. Available current and voltage input modules

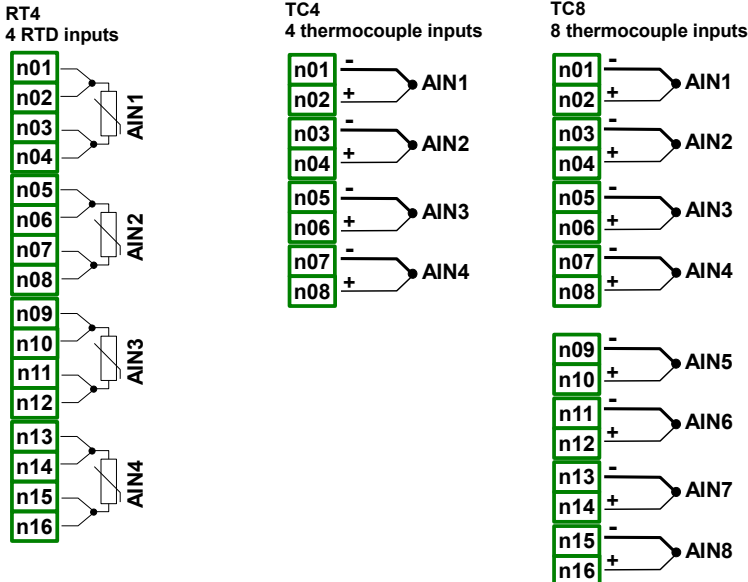


Fig. 4.10. Available RTD and TC input modules

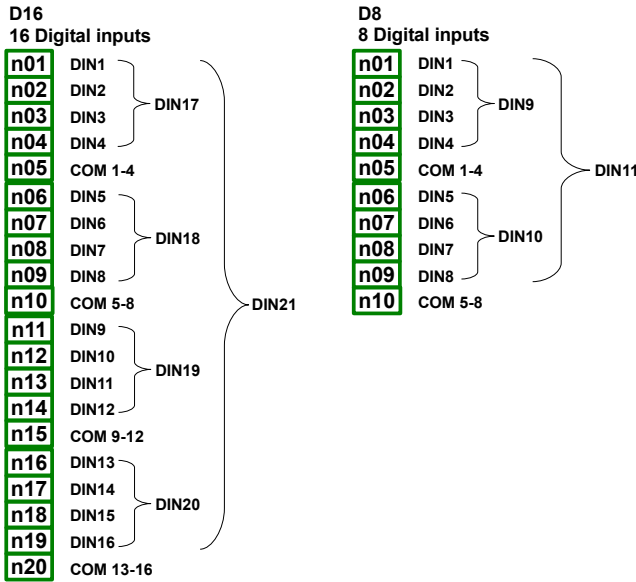


Fig. 4.11. Available Digital input modules

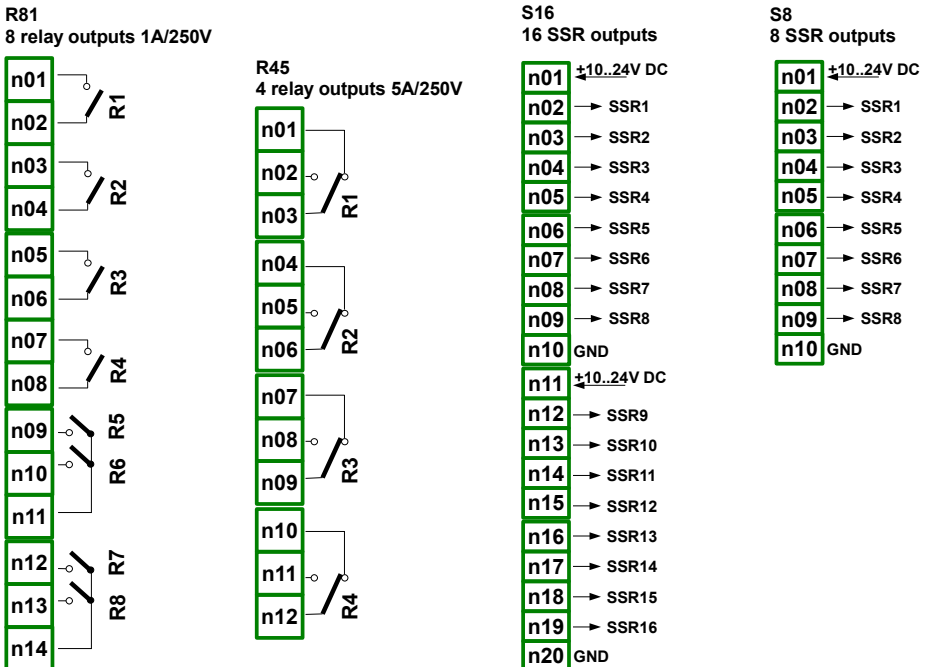


Fig. 4.12. Available output modules

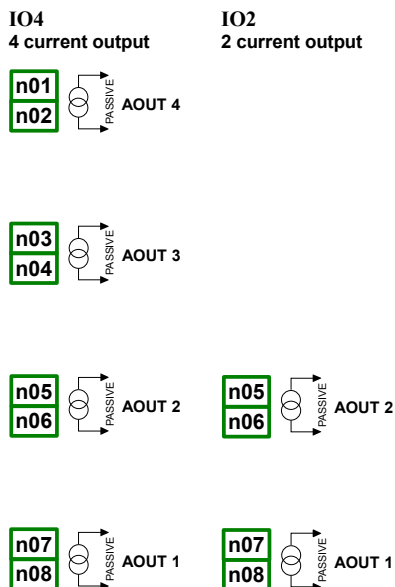


Fig. 4.13. Available passive current output

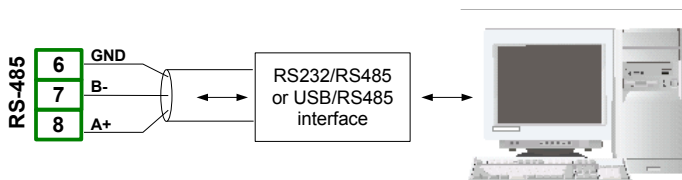


Fig. 4.14. Connection of RS-485 transmission signals

The **CMC-99** device supports the following converters:

- USB / RS-485 converter (**SRS-USB/4-Z45**)
- RS-232 / RS-485 converter (**SRS-2/4-Z45**)

4.4. MAINTENANCE

The unit does not have any internal replaceable or adjustable components available to the user. Pay attention to the ambient temperature in the room where the unit is operating. Excessively high temperatures cause faster ageing of the internal components and shorten the fault-free time of unit operation.

In cases where the unit gets dirty do not clean with solvents. For cleaning use warm water with small amount of detergent or in the case of more significant contamination ethyl or isopropyl alcohol.



Using any other agents can cause permanent damage to the housing.



Product marked with this symbol should not be placed in municipal waste. Please check local regulations for disposal and electronic products.

5. INTRODUCTION TO *MULTI*CON

5.1. UNDERSTANDING *MULTI*CON CMC-99

The **MultiCon CMC-99** were developed as universal multichannel controller. To maintain this concept also its firmware was written with multi level structure. The device runs under control of LINUX operating system keeping all subsystems ready to use and allowing independent and simultaneous operation of many processes (communication, data acquisition, post-processing, visualisation etc.). Such approach gives great advantages of highest level application, making it flexible and dynamically configurable. Similarly data structures and streams was implemented in a quite different way than in most of similar devices. The main difference is the concept of **Logical Channels** as a bridge: physical inputs and outputs - visualisation and controlling processes. Designers of **MultiCon** decided to use such solution to increase functionality of the device and make software near fully independent on the hardware.

5.1.1. Logical channels

Logical Channel is a data stream existing in memory of the device, having it's name and could be displayed, used as input data for controlling process (or processes), controlling of physical output or as input data of other **Logical Channels**. The **CMC-99** can contain as much as 60 **Logical Channels**, every of these channels can be configured to represent: measurement data from build in physical input channels, states and output data of physical output channels, states and data coming from outputs of controlling processes, states of virtual input channels and timers, or mathematical combination of other **Logical Channels**. To make visualization more clear **Logical Channels** can be gather into a **Groups**.

5.1.2. Groups

The **Group** is a set of 1-6 **Logical Channels**. **CMC-99** can visualize on the same screen only channels belonging to the same **Group**, additionally **Groups** has their individual names what makes operation with device very clear. Every **Logical Channel** can belong to one or more groups simultaneously, and also not to belong to any group (then may not be visualized, but still can be used for other processes). It is common that channels belonging to the same **Group** are related one to another in some way (for example representing parameters of single object or representing similar parameters of few separate objects) but it is also possible to create a **Group** consist of completely unrelated channels.

The use of **Groups**, **Logical Channels** and mathematical combinations of them gives incredible flexibility of the software, allowing easy designing or advanced controlling methods and its visualisation with low cost **MultiCon CMC-99**.

Example:

We can measure only *voltage* and *current* of some heater, but we would like to observe and control average power emitted by this heater. First at all we define 3 **Logical Channels** - first fed with data from *voltage* input, second fed with data from *current* input, and third fed by result of multiplication of **Logical Channels** 1 and 2 then gather them into a single **Group** named *HEATER*. In this way we can display 3 graphs on the screen: voltage, current and power of the heater. Moreover the third channel can then be used as input for regulation of power emitted by the heater and control build in physical relay. Additionally state of the relay can fed fourth **Logical Channel**. To display state of the relay, it is necessary to add it to the same **Group** together with previous three channels.

5.2. HARDWARE CONFIGURATIONS

The functionality of **CMC-99** can be fit to the user's needs. The **base** of **CMC-99** contains: main processor, display with touch-screen, Switch Mode Power Supply (in one of two versions: 24V and 85-260V) and basic communication interfaces like USB and RS485. See Fig. 4.7 - most left connectors. All other modules are optional and can be installed inside the device according to customer's order. Next to basic connectors is a place of advanced communication module. In the simplest version this module can be equipped only with rear USB Host connector (this is standard fitments for IP-65 version of the **CMC-99**). Full version of this module contains also 2 additional serial ports (RS485 and RS485 split with RS232) and 10Mb Ethernet RJ-45 connector.

Three slots designed for build in hardware inputs and outputs are installed on the right side of the case (see Fig. 4.7, terminals marked: slot A, slot B and slot C). The actual view of these terminals varies depend on module type. Shortened descriptions of available modules' terminals are shown on Fig. 4.9-4.12. Measurement and actuators modules are constantly developed, so current list of available modules varies (visit www.simex.com.pl to check current list of **CMC-99** modules). Basic measurement modules are: 4/8/16x Voltage/Current input module, 4x RTD input module and 4/8x TC input module. Output modules are: 8/16x SSR driver module or 8x Relay 1A/250V, 4x Relay 5A/250V modules and 2/4x IO passive current output.

6. WORK WITH CMC-99

6.1. CMC-99 POWER ON

After power on a starting Logo is showed on **CMC-99** display. While operation system is being loaded a progress bar is visible in the middle of the screen. After that main application is started. During this process screen may stay dimmed by 3-5 seconds. Please wait until end of this operation before starting to operate with the device.

6.2. THE USE OF TOUCH-SCREEN

It is prohibited to use pointers with sharp edges (like knives, scissors, needles, wires, nails, bolts etc.) while work with touch-screen. It is strongly recommended to use special stylus made of plastic or other soft material with smooth ends (for example stylus delivered with the device). The display of **CMC-99** should be also protected against aggressive substances and extremely high and low temperatures that can cause damages.



For cleaning a special liquid designed for LCD screens and soft cloth should be used.

6.3. DISPLAY

MultiCon displays all data and dialogues on 3,5" 320x240 pixels, colour TFT screen. New devices has display protected with transparent thin foil. This protective layer should be removed before use to ensure perfect visibility of pictures and sensitivity of touch-screen which is used to operate with the device.

While normal operation **CMC-99** displays data in a form selected by user, but at any time it is possible to switch presentation mode or enable configuration dialogue boxes. All details of the user interface are fit up to make use of device easy and intuitive. To change displaying mode or enter menu touch the screen of **CMC-99** with stylus. Further information about menu and presentation modes are described in further chapters.



Detailed description of all elements visible on the screen are contained in further chapters.



Fig. 6.1. Typical view of **CMC-99** main application

6.3.1. Information bar

Information bar informs user about current group, logging, date and time. In place of standard name it is possible to enter more descriptive for clearance. Logging indicator used to show the operations related to logging. Indicator may shine in 3 colours: grey, blue and yellow which means disable, active and save the samples into memory, respectively. Current date and time presented in upper right corner can be changed using appropriate menu (see chapter: **CONFIGURATION OF CMC-99**).

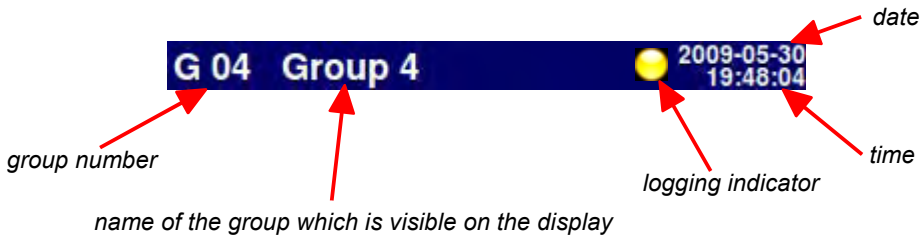


Fig. 6.2. View of information bar



If the logging indicator light yellow (save the samples into memory) don't turn off the device because the date will be lost

6.3.2. Navigation bar

The touch of the screen at any place causes displaying of navigation bar.

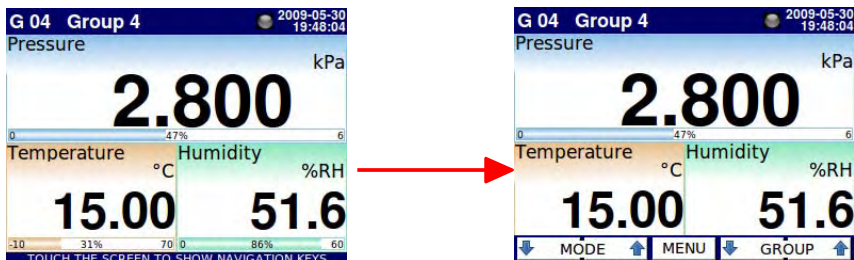


Fig. 6.3. Main window of device – running navigation bar

This bar contains three kinds of buttons:

	switching between visualisation modes of current group
	entering the main menu (see details in paragraph: CONFIGURATION OF CMC-99)
	switching between presented group of channels



To enter directly into configuration menu of particular channel, press and hold screen over the channel data panel for 3-4 seconds. Similarly to go directly to configuration of displayed group, touch and hold for few seconds upper information bar. In both cases if password is set then user has to enter the password before entering the configuration.

6.3.3. Data panels

The great deal of screen is being used for channels visualisation. Data can be presented in one of few modes (as numerical values, as charts, as bars and as needles). All channels of current group are simultaneously presented in the same mode. In the current version of software there is no possibility to mix different modes in one view. Figures 6.4 – 6.8 show examples of different views. The switching between visualisation modes can be done invoking bottom navigation bar and pressing buttons **[MODE↑]** or **[MODE↓]**, (see paragraph: **Navigation bar**)

On every data panel there are available following informations: channel data value, data unit, channel's name and number of **Logical Channel**, on some modes there is also visible percentage indicator of value in the relation to it's full scale.

Every **Group** of **Logical Channels** can be presented in one of 6 modes:

- as numerical values Fig. 6.4
- as horizontal bars Fig. 6.5
- as vertical bars Fig. 6.5
- as horizontal charts Fig. 6.6

- as vertical charts Fig. 6.6
- as needles Fig. 6.7

There is also possibility to show many groups on single screen (Fig. 6.9). In this mode particular channels belonging to the same group are displayed one under another, and particular groups are placed side by side. As much as 5 groups can be displayed simultaneously on single screen.



Fig. 6.4. Examples of **Numerical Values** presentation mode

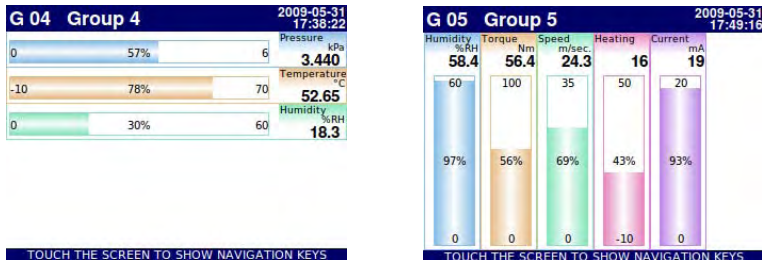


Fig. 6.5. Examples of **Horizontal and Vertical Bars**



Fig. 6.6. Examples of **Horizontal and Vertical Charts**

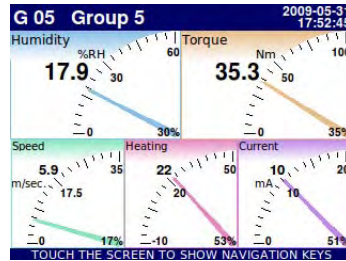
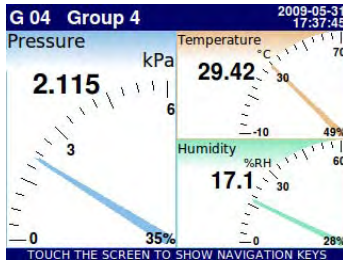


Fig. 6.7. Examples of **Needles**

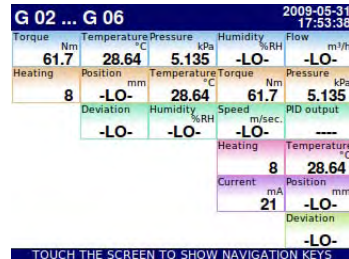
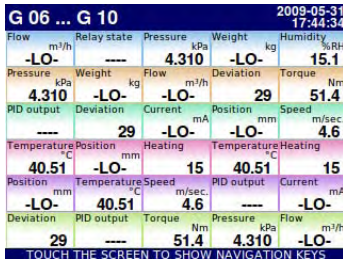


Fig. 6.8. Examples of simultaneous presentation of **Many Groups**

6.3.4. Important messages

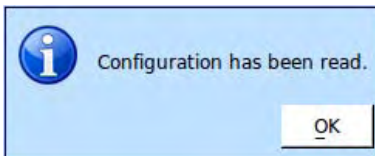


Fig. 6.9. Information message

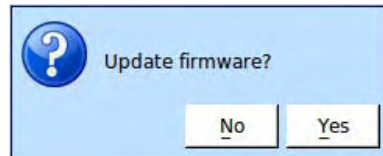


Fig. 6.10. Question message

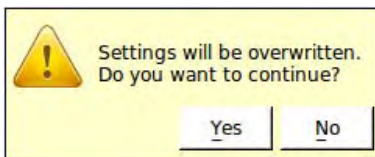


Fig. 6.11. Warning message

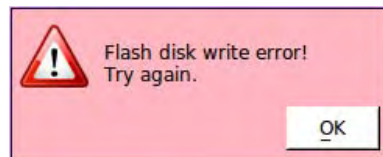


Fig. 6.12. Alert message

7. CONFIGURATION OF CMC-99

7.1. EDIT DIALOGUES

Configuration process bases on edit dialogues. Some of the dialogues are commonly used by different menus, such dialogues are: text editor – Fig. 7.1 - 7.5, values editor – Fig. 7.6, and switch mode editor Fig. 7.9. There are also dialogues specific for some settings - these specific dialogues are showed and described if necessary.

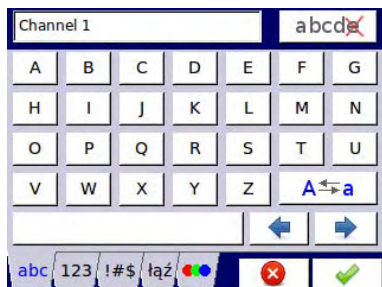


Fig. 7.1. Text editor – letters

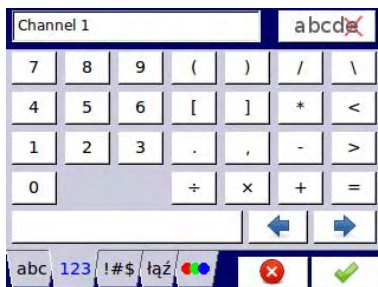


Fig. 7.2. Text editor – numbers

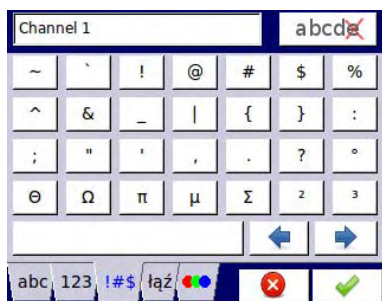


Fig. 7.3. Text editor – special symbols

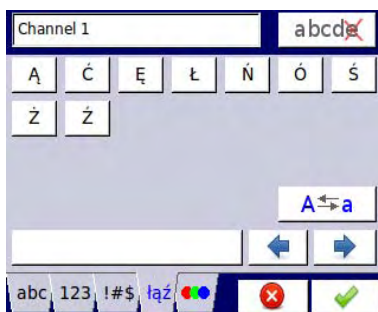


Fig. 7.4. Text editor – national letters

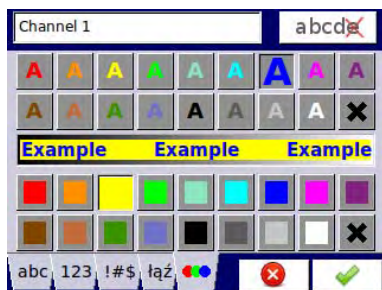


Fig. 7.5. Text editor – font and background colours selection

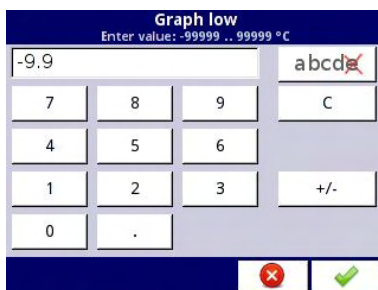


Fig. 7.6. Value editor – decimal form

Fig. 7.7. Value editor – hex form

Fig. 7.8. Value editor – binary form








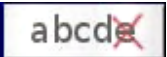
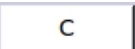
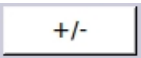




Fig. 7.9. Single switch type editor

Fig. 7.10. Multiple switch type editor

Fig. 7.11. File editor

Fig. 7.12. File editor

Functions of common buttons

	"Exit" - exits from current menu or sub-menu
	"OK" - allows to accept choice or changes of edit dialogue (and exit from this dialogue)
	"Cancel" - allow to reject entered choice or changes of edit dialogue (and exit from this dialogue)
	Selection of element for edition. Arrow buttons allow to select successive elements (groups, logical channels, controllers or outputs). Middle button allows direct selection of particular element from the list.
	Navigation keys in switch type dialogues.
	Move arrows. Allow to move cursor on the edited text.
	"Caps lock" - switches between lower and upper case letters.
	"Backspace" . While value editing pressing this button deletes last visible number. While text editing last edited symbol or symbol showed directly before cursor.
	"Clear" - clears whole number while editing of the values.
	"Sign" - changes sign of edited value.
	This button allow to delete selected file.
	"All" - selects all the available options.
	"None" - disable all the available options.
	Pressing this button allow to use Text editor window.

7.2. MAIN MENU SELECTION PANEL

Pressing **[MENU]** button of **Navigation bar** enters main selection panel (Fig. 7.13). This panel allows to select between entering the **Device Configuration**, **Files management** and **Device Information** screen.



Fig. 7.13. Main menu window

Safe shutdown button allow to safe power off the device. After pressing the button and accepting the **warning message** the screen will be look like in the Fig. 7.14.



Fig. 7.14. The screen after pressing the Safe shutdown button

7.3. FILES MANAGEMENT

This menu is for managing files i.e. to transmit and receive data to the flash memory. The main menu is shown in the Fig. 7.15. There are 2 parameters: **Recordings** and **Configuration**. **Recording** parameter allow to management recordings files. Available only in the case of buying a licence key. In the absence of this license in the **Files management** menu, there is only once parameter – the Configuration files. Menu parameter **Recordings** is shown in the Fig. 7.16.

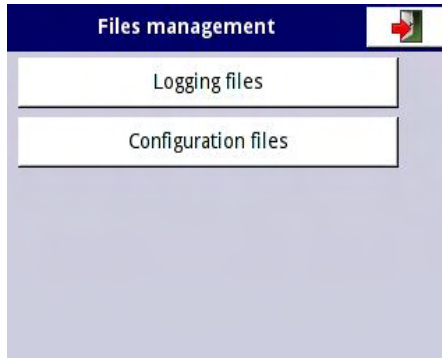


Fig. 7.15. Files management menu

In order to export selected logging files we select appropriate group of selected files logging (see Fig. 7.18) and then connected to a device with flash memory we press the **Export selected files** button. The symbol "----" means that no logging files in the group was not selected. Descriptions of files are defined in the menu **Groups** (see Chapter 7.13 Groups). Similarly, to export logging files does delete files. In order to delete files after selected files in appropriate groups we click **Delete selected files** button.



Fig. 7.16. View of the "Logging files" menu

Second parameter in the Management files is Configuration. After enter in the submenu user can Load/Save the configurations and templates. **CMC-99** Allow load/save configurations defined by user, i.e. general settings, logical channels, build-in output, modbus settings, profiles/timers, controllers and group. Sample view window when configuration is changes shown in the Fig. 7.17. Save/load templates modbus allow to save/load configuration settings for the Modbus protocol, i.e. name, channel configuration of the device (the list of inputs and outputs) and the register blocks (Block list). - see Chapter 7.14 Modbus. Having saved these templates modbus we can at any time to quickly communication between CMC-99 and SLAVE device only select appropriate address of SLAVE device.

The process of exchanging files: configurations or templates modbus between the device and flash memory starts after when you connect flash memory to CMC-99. Then enter **Files management** → **Configuration files** menu. If we want to Load files than in the window panel will appear image of flash memory with available configurations or modbus templates files for configurations or with extension **.cfg** or **.mcfg** respectively. Please note that name of files is set by user. If we want to save files after pressing button Save configuration or Modbus templates appears window panel with available files that can be appropriately called by pressing the button with the symbol keys in the upper left corner. Next we confirm the save and after few moments the date is stored in flash memory. Sample configuration files are placed in Fig. 7.18.

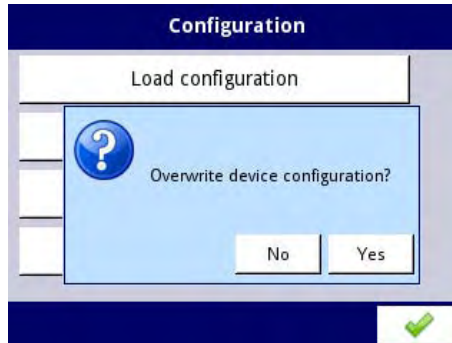


Fig. 7.17. View window when the configuration changes

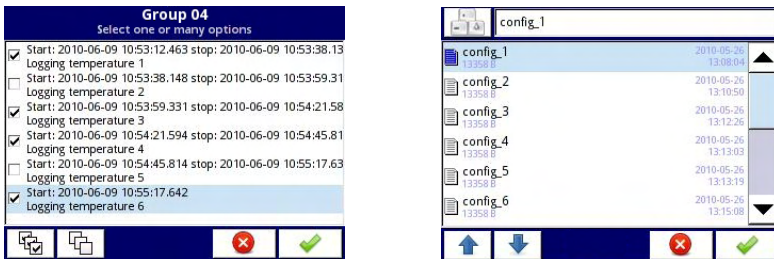


Fig. 7.18. Example of logging and configuration files

7.4. DEVICE INFORMATIONS, LICENSE AND FIRMWARE UPDATE

This screen gives basic informations about software and hardware of the device.



Fig. 7.19. Device Information screen

Firmware update button gives possibility for easy maintaining of up to date firmware version. Before updating user has to download the newest version of software from www.simex.com.pl and store it on Flash Disk. Next insert Flash Disk into USB host port of **CMC-99** and run update process pressing Firmware update button. During updating it is prohibited to switch off the power or remove Flash Disk from USB port. Broken or careless updating can cause device damage.

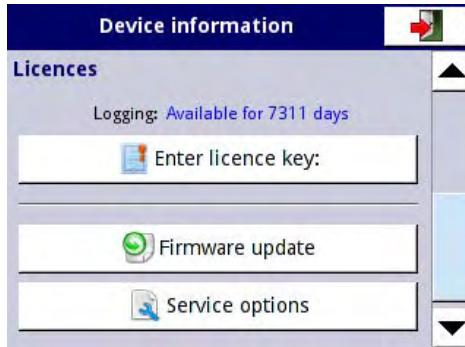


Fig. 7.20. Device information menu

To prevent accidental running of update process additional confirmation warning is displayed.

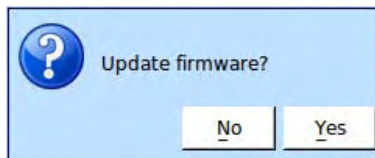


Fig. 7.21. Confirmation dialogue

Enter licence key button allow to enter license key depending on the user receives additional software options to increase functionality of the device.

Service options button is protected password and unavailable for user.

7.5. MAIN MENU

To avoid settings against accidental or unauthorized change user has to enter the **Password** before entering configuration menu. If user set protection, then before entering deeper settings dialogues an ask for password is displayed.

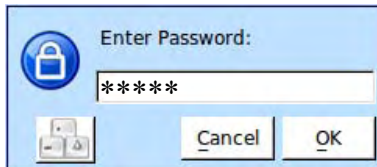


Fig. 7.22. Enter password dialogue



This button invokes software keyboard window allowing enter the password. While password entering, letters are replaced with star signs.

If incorrect password is entered then appropriate warning is displayed Fig. 7.23 and configuration is impossible.

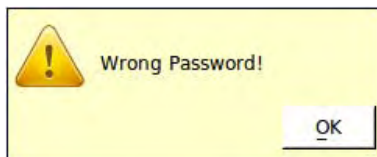


Fig. 7.23. Warning message after wrong password entering

If entered password is correct then main menu selection panel appears (Fig. 7.24).

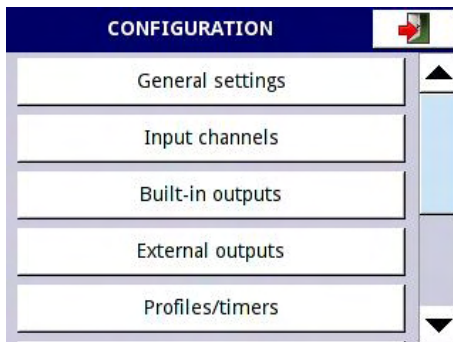


Fig. 7.24. Main menu selection panel

To exit from this menu (with configuration changed or not) press **Exit button** located in upper right corner of the screen. Due to configuration process operates on-line it is necessary to

confirm entered changes. Choice panel is displayed, and user can **Save changes** or **Revert** configuration to previous state.

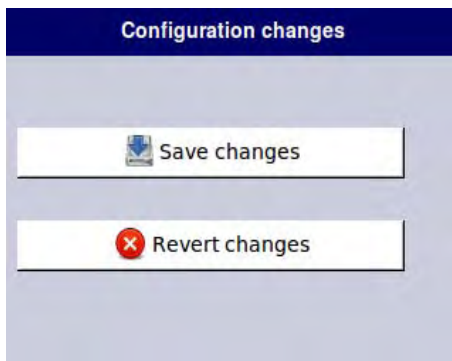
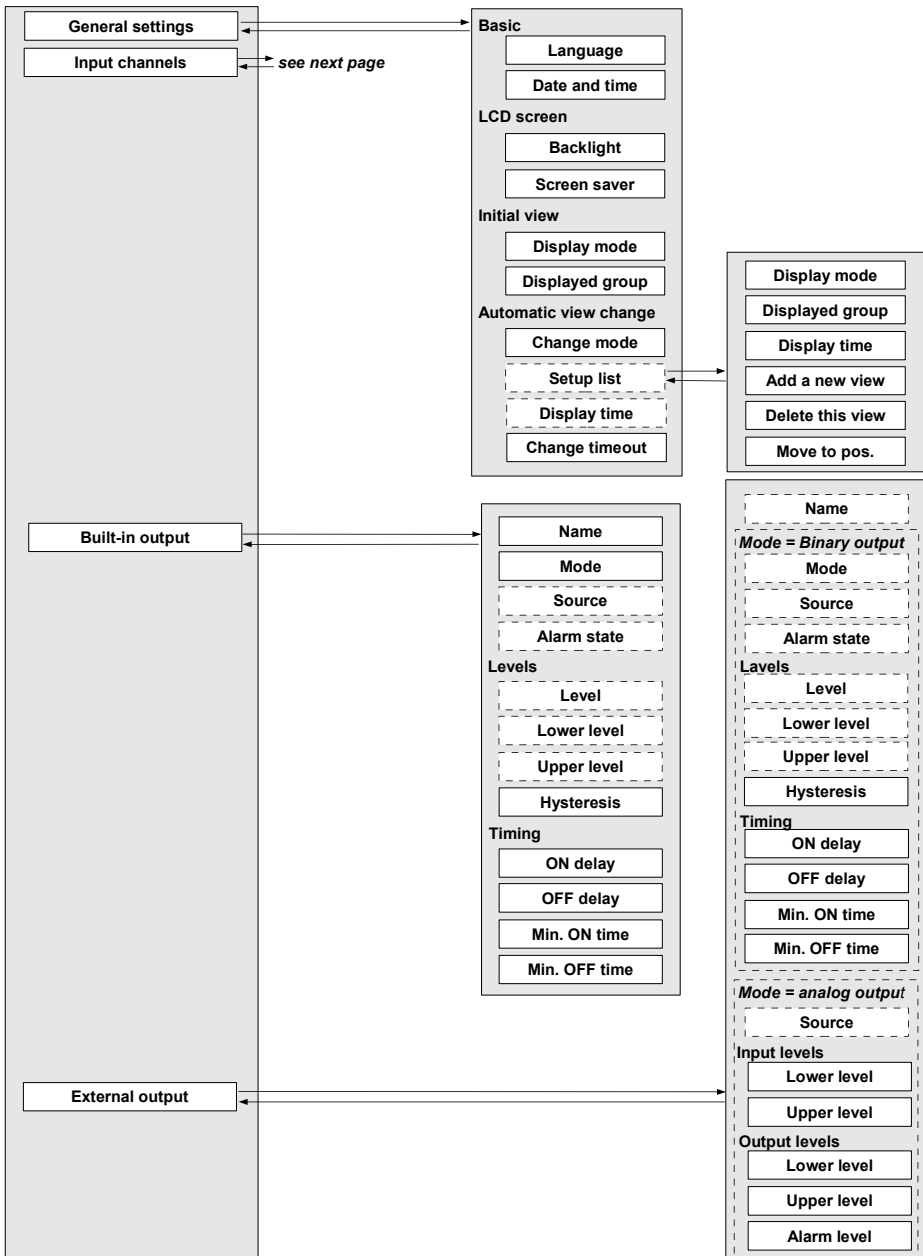
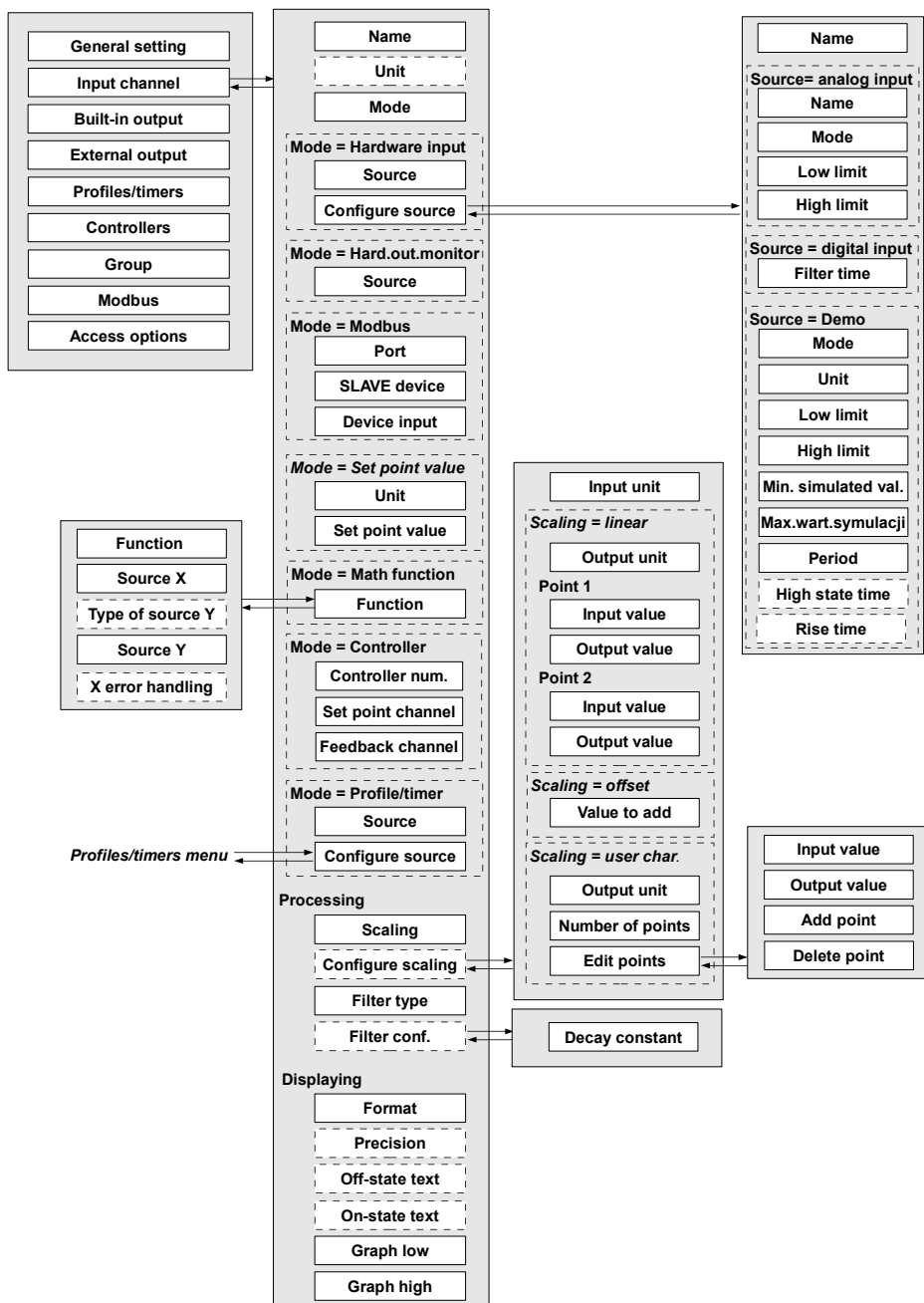
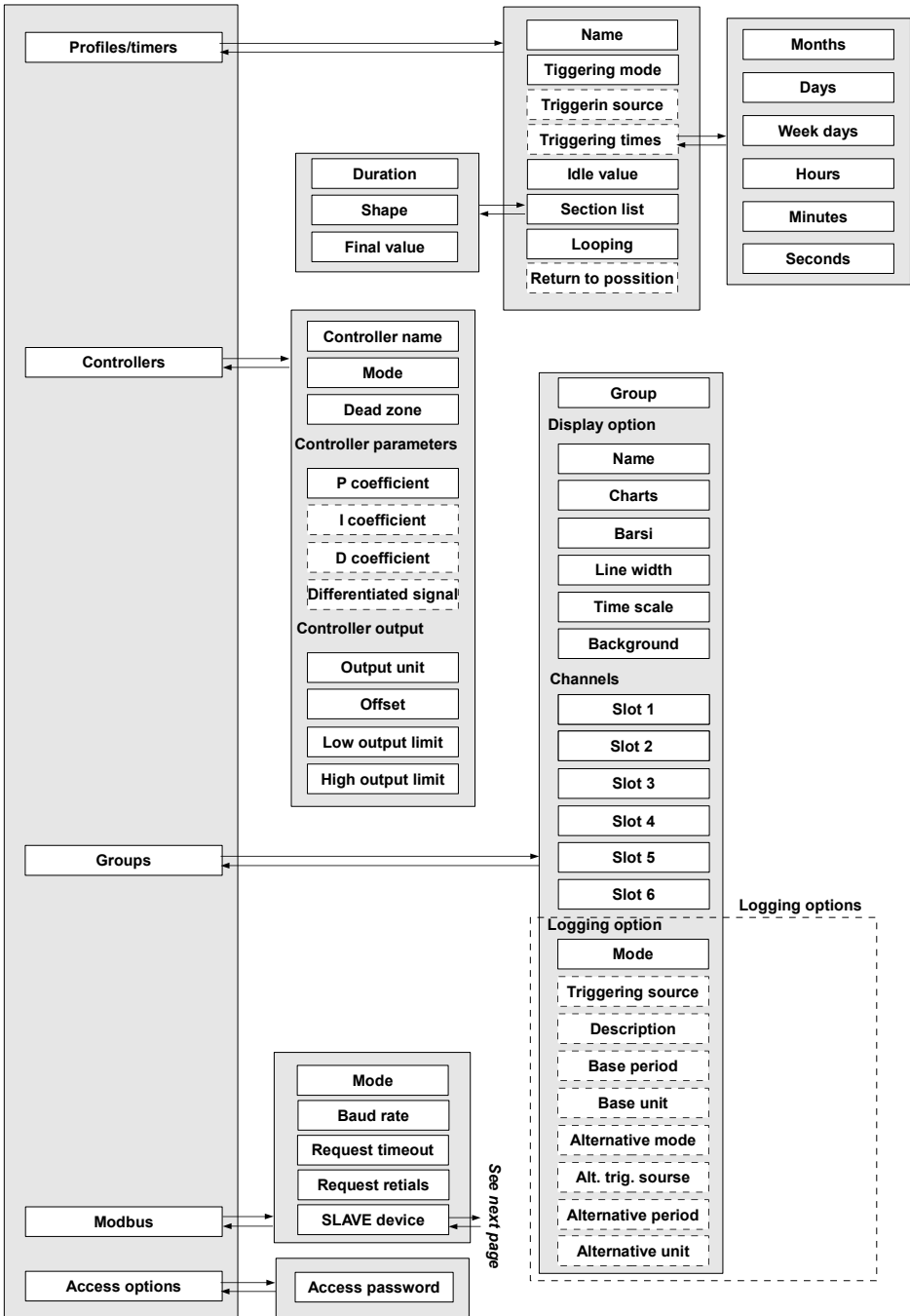


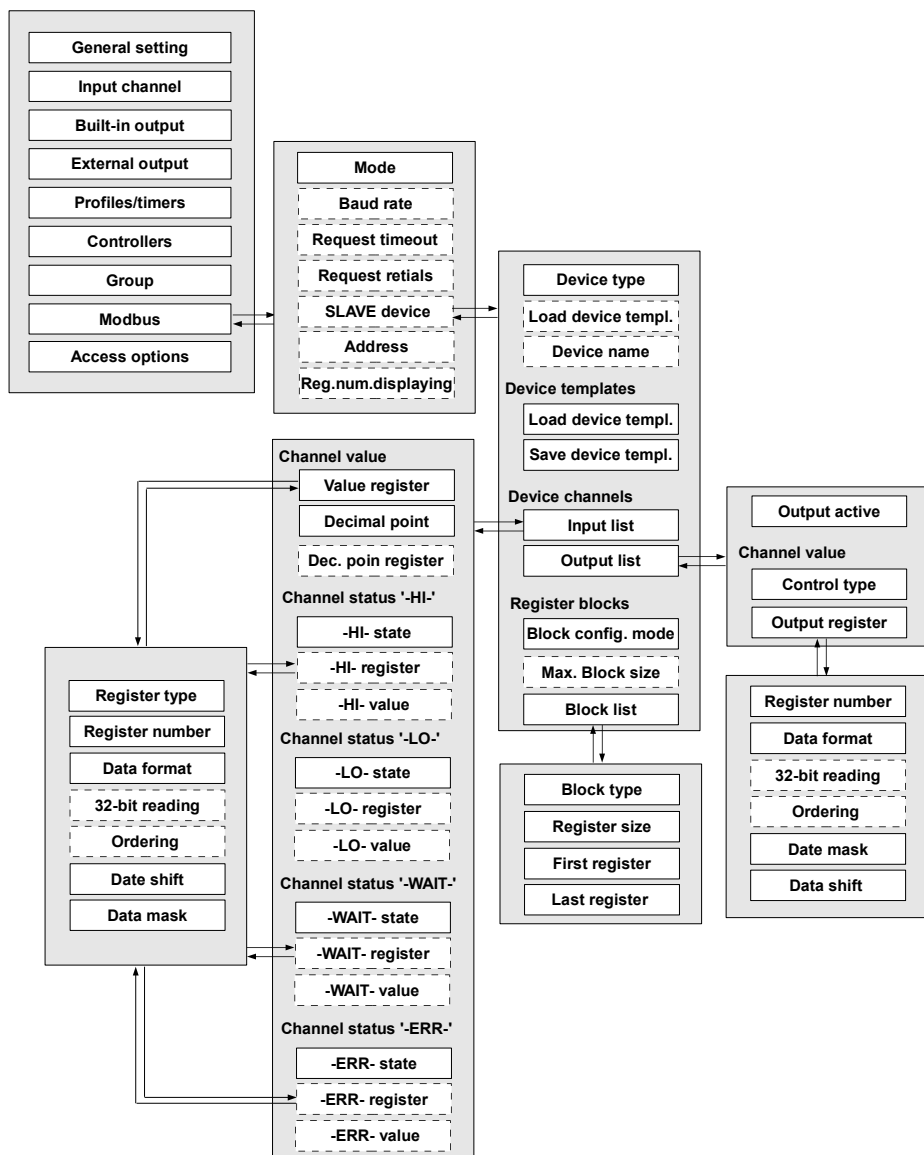
Fig. 7.25. Save / revert changes window

7.6. CONFIGURATION MENU STRUCTURE









7.7. GENERAL SETTINGS

General settings are used to configure main parameters of the user interface, appearance of the device after power up and automatic data presentation events. Figure 7.26 shows settings of user interface: language, date and time, backlight, and screen saver.

The screenshot shows a 'GENERAL' settings menu. It includes fields for 'Language' (set to 'english'), 'Date and time' (set to '06-06-2009 22:11:57'), and an 'LCD screen' section with 'Backlight' (set to '100%') and 'Screen saver' (set to 'disabled'). A green checkmark button is at the bottom right.

Fig. 7.26. General Settings – interface settings

Figure 7.27 shows settings of initial view: **Group** and it's visualisation mode. If user needn't automatic changes of displayed group or mode then can leave **Automatic view change** disabled. If any auto operations are required then user can select one of few changing methods, also additional fields on the **General Settings** appear.

The screenshot shows the 'GENERAL' settings menu with the 'Initial view' section expanded. It includes 'Display mode' (set to 'needles') and 'Displayed group' (set to 'Group 1: "Group 1"'). The 'Automatic view change' section shows 'Change mode' set to 'disabled'. A green checkmark button is at the bottom right.

Fig. 7.27. General Settings – Initial view settings.

Figure 7.28 shows view of the **General Settings** after enabling automatic changes of visualisation modes or groups. Additional fields allow to select period of particular mode/group visibility - **Display time** and **Change timeout** (time to the first auto action after last manual change of the mode or group).

GENERAL

Displayed group: Group 1:"Group 1"

Automatic view change

Change mode: change modes

Display time: 5 sec.

Change timeout: 10 sec.

GENERAL

Displayed group: Group 1:"Group 1"

Automatic view change

Change mode: change groups

Display time: 5 sec.

Change timeout: 10 sec.

Fig. 7.28. General Settings – automatic changes of modes or groups

If **Change mode** is set to **detailed list** mode then in place of **Display time** parameter an **Setup list** button is displayed (Fig. 7.29 left). After pressing this button additional submenu window appears, allowing defining of successive views (Fig. 7.29 right).

GENERAL

Displayed group: Group 1:"Group 1"

Automatic view change

Change mode: detailed list

Setup list

Change timeout: 10 sec.

View: [down arrow] 1 [up arrow]

Display mode: values

Displayed group: Group 1:"Group 1"

Display time: 5 sec.

Add a new view

Delete this view

Fig. 7.29. General Settings – automatic changes of modes and groups

To create additional views use **Add a new view** button, to delete current view press **Delete this view**. Selection of currently edited view can be done by pressing arrows on upper bar. Pressing number allows to jump directly to definition of required view (appropriate number of views must be firstly defined).

7.8. INPUT CHANNELS

This sub-menu is used for configuration of **Logical Channels**. It is named **Input Channels** to suggest user that data (values) of defined here channels can be treated as input data for outputs, controllers or other **Logical Channels** and can be collected into a **Groups** for simultaneous visualisation. To see detailed definition of **Logical Channel** see **Introduction to MultiCon**



To jump directly into configuration mode of particular **Logical Channel** touch and hold for few seconds data panel of this channel on display while data visualisation. If password is set then user has to enter the password before entering the configuration.

7.8.1. Input Channels general settings

There is available as much as 60 **Logical Channels**. Every channel has its individual name. To change it, simply press button next to label **Name**. In hardware input mode **Unit** is related to the source channels, and for Demo can be changed after pressing **Configure source** button. For **Set point value** mode and **Controller** mode unit is free definable directly from main window of **Logical Channel** configuration. If **Scaling** is enabled then unit can be redefined by **Output unit** parameter in scaling configuration menu (see Fig. 7.36).

Log. channel: 9

Name: Temperature

Unit: °C

Mode: Hardware input

Source: Inp.3.11: TestA

Configure source

Fig. 7.30. Input channels menu – **Logical Channel** general settings

Parameter **Mode** defines the kind of data source of the **Logical Channel**. User can select one of 8 modes – (disabled, Hardware input, Hardware output monitor, Modbus, Set point value, Math function, Controller and Profile/timer). If **Logical Channel** is disabled then there are no other parameters to set. Every other mode enables different set of parameters for configuration. All of them enables parameters for configuration of **Displaying** Fig. 7.31

Log. channel: 9

Displaying

Format: numeric

Precision: 0.00

Graph low: -10 °C

Graph high: 70 °C

Log. channel: 9

Format: binary

Off-state text: OFF

On-state text: ON

Graph low: -10

Graph high: 70

Fig. 7.31. Input channels menu – two views of parameters for **Displaying** configuration

Numeric format of the data can be expressed with desired precision. However user should remember that measurement resolution and precision of external sensors are finite, and usually not better than 0.1%.

Binary format of data allow to select strings (texts) for it's on and off state. This strings can describe the state of sensor or output. It is possible to input any string with desired background and foreground colour. Also empty string (spaces) is possible, in this case the text can pretend kind of LED indicator.

Both data formats (numeric and binary) allow to define lower and upper limits of the graph. This parameters gives possibility to set scale of the graph values making it readable. Time scale of the graph is common for whole **Group** and can be set using **Groups** menu.

7.8.2. Input Channels settings for Hardware input and Hardware output monitor modes

When **Logical Channel** is switched to mode *Hardware input* then parameters related to hardware are displayed Fig. 7.32.

Log. channel: [down arrow] 9 [up arrow]

Name: Temperature

Unit: °C

Mode: Hardware input

Source: Inp.3.11: TestA

Configure source

[green checkmark]

Fig. 7.32. Input channels menu – parameters specific for **Hardware Input** mode

Parameter source allows to select physical input channel, and button **Configure Source** enters additional panel specific for selected input source. Shortened description of configuration of the physical inputs are shown on Fig. 4.9-4.12 devoted to particular measurement modules.

Selection of **Hardware output monitor** mode causes displaying configuration menu as presented in Fig. 7.33.

Log. channel: [down arrow] 8 [up arrow]

Name: PID output

Unit: none

Mode: Hardware output monitor

Source: Out.V7 : VRelay

Processing

[green checkmark]

Fig. 7.33. Input channels menu – parameters specific for **Hardware Output Monitor** mode

In both these modes there are also visible configuration parameters for **Processing** (Fig. 7.34). Processing allows to recalculate incoming data (add offset or transform them according to linear or user defined characteristic). Panels for configuration of different types of scaling are presented in figures 7.35 – 7.37.

Fig. 7.34. Input channels menu – parameters for **Processing** configuration

Fig. 7.35. Configuration of **Offset** type scaling

Fig. 7.36. Configuration of **Linear** scaling

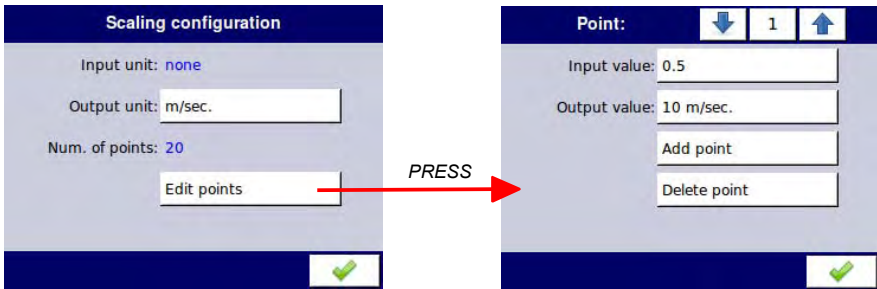


Fig. 7.37. Configuration of **User characteristic** scaling

When **User characteristic** is selected then edition of up to 20 points is possible. Pressing **Edit points** button (fig. Fig. 7.37) invokes point configuration window.

Filter allows to smooth incoming data. Figure 7.38 presents settings of Exponential filter mode.

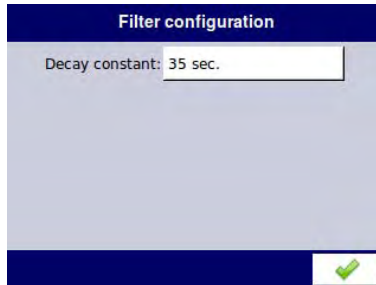


Fig. 7.38. Configuration of **Exponential** filtering

7.8.3. Input Channels setting for Modbus mode

Input channel parameters available for Modbus mode are presented in figure Fig. 7.39.

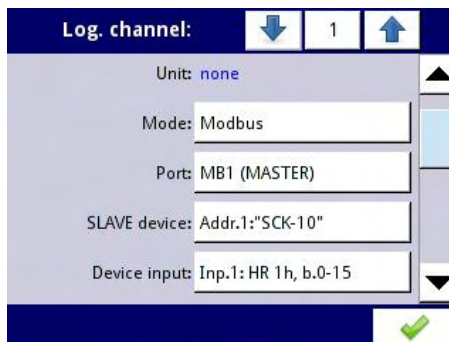


Fig. 7.39. Input channels menu - parameters specific for Modbus mode

If you want to read a data come from external device by RS-485 you must firstly set parameters for MASTER mode in Modbus menu (see Modbus). Next you go to Logical channel and change mode to Modbus. Additionally it is necessary to choose appropriate **Port**, **SLAVE device** (it mean SLAVE device address) and **Device input** – register Slave device. Other enables set of group parameters for configuration into Modbus mode are Processing and Displaying.

For more information about Modbus protocol implemented into **CMC-99** device see chapter 7.14 Modbus.

7.8.4. Input Channels settings for Math function and Set point value mode

CMC-99 device is richly endowed with a wide variety mathematical function which increased functionality and range of applications device. Figure Fig. 7.40 presents parameters of Input channel into Math function mode.

The screenshot displays the configuration interface for an input channel in Math function mode. At the top, 'Log. channel:' is set to '1'. Below, the 'Name' is 'Channel 1', 'Unit' is 'none', 'Mode' is 'Math function', and the 'Function' is '[2] + [3]'. A 'Processing' button is visible at the bottom left, and a green checkmark icon is at the bottom right.

Fig. 7.40. Input channels menu - parameters specific for Math function mode

In addition to basic mathematical functions such as addition, subtraction, multiplication, division the unit allows you to manipulate logical functions, operations on arrays, determining the arithmetic mean value, searching for the minimum and maximum values and many other functions that are described in the table below.

Math function	Description	Example
X+Y	The sum of two channel or channel and constant value	[1] + [2] – The sum of channel 1 and 2
X-Y	The subtraction of two channels or channel and a constant value	[1] - [2] – The subtraction of channel 1 and 2
X/Y	The ratio of two channels or values of the channel and a constant value	[1] / [2] – The ratio of the channel 1 to channel 2
X*Y	The product of two channel or values of the channel and a constant value	[1] * [2] – The product of channel 1 and channel 2
(X>0) AND (Y>0)	Logical AND	[1] AND [2] - result = 1, when the value of channel 1 and 2 is greater than 0

$(X>0) \text{ OR } (Y>0)$	Logical OR	[1] OR [2] – result = 1, when the value of channel 1 or/and 2 is greater than 0
$(X>0) \text{ XOR } (Y>0)$	Logical XOR	[1] XOR [2] – result = 1, when the value of the of one channel is greater than 0 and the value of second channel is less than or equal to 0, when both channels have values less than or equal to 0 or when both channels have values greater than 0 then the result is 0
SUM X[i]	The sum of selected channels	SUM[1,2,3,4] – The result is the sum of channels 1, 2, 3, 4
MEAN X[i]	The mean value of the selected channels.	MEAN[1,2,3,4] – The result is the arithmetic mean value of channels 1, 2, 3, 4
MULT X[i]	The product of the value of the selected channels.	MULT[1,2,3,4] - The result is the product of channels 1, 2, 3, 4
MIN X[i]	The smallest value of selected value of the selected channels	MIN[1,2,3,4] - The result is smallest value of the selected channels 1, 2, 3, 4
MAX X[i]	The largest value of selected value of the selected channels	MAX[1,2,3,4] - The result is largest value of the selected channels 1, 2, 3, 4
ANY X[i]>Y	The result = 1 if the value of any set of selected channels is greater than the value of the channel or constant value Y	ANY[1,2,3,4]>[5] – If the value of any set of channel 1, 2, 3, 4 is greater than the value of the channel 5 then the result is 1, otherwise it will be 0
ALL X[i]>Y	The result = 1 if all values of selected channels are greater than the value of the channel or constant value Y	ALL[1,2,3,4]>[5] – The result is 1 if all values of channels 1, 2, 3, 4 are greater than the value of the channel 5
ANY X[i]<Y	The result = 1 if the value of any set of selected channels is less than the value of the channel or constant value Y	ANY[1,2,3,4]<[5] - If the value of any set of channel 1, 2, 3, 4 is less than the value of the channel 5 then the result is 1, otherwise it will be 0
ALL X[i]<Y	The result = 1 if all values of selected channels are smaller than the value of the channel or constant value Y	ALL[1,2,3,4]<[5] – The result is 1 if all values of channels 1, 2, 3, 4 are less than the value of the channel 5

X[i] selected by Y	The result is a value of channel from list of channel X which selected by the value of channel Y	[1,2,3,4]selected by[5] -By the value of the channel 5 corresponding value is selected from channels 1, 2, 3, 4 (See the <i>Example 7.8.7...</i> Chapter 7.8.7)
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In order to settings of mathematical functions we go to the **Function** submenu, whose view of the window shown in Fig. 7.41. In submenu except the Source type parameter which allows choice of the channel or constant value as the value of Y, there is also the **Error Handling** parameter in which user can choose whether or not to relay error signal to the result.

Fig. 7.41. Function submenu in the Math function mode

A special mode of **Logical Channel** is **Set point value** mode. This one can be used for definition of Set points of controlling processes (see next chapter), and also as definable constant parameter for **Math function**.

Fig. 7.42. Configuration of **Math function** and **Set point value** type source

7.8.5. Input Channels settings for Controller mode

To create **controlling process** the **Logical Channel** should be set in **Controller** mode. In this mode displayed **Unit** is fully definable, and user has to select which **Controller profile** has to be used (see menu **Controllers**), and also source of **set point** data and **feedback** channel

(input data for controlling process). Set point of control process can be driven from any **Logical Channel**, but for purposes where constant value is needed, use **Set Point value** type **Logical Channel**. Feedback data in controlling processes is usually a measurement signal from the object, so **Logical Channel** representing such a signal has to be defined first. Output of **Logical Channel** switched to **Controller** mode can drive a hardware output, and be visualised or used as input for other **Logical Channels**.

To read more about **Controllers profiles** see chapter **7.12 Controllers**.

Fig. 7.43. Configuration of **Controller** type source

7.8.6. Input Channels setting for Profile/timer mode

To use this mode in the **Input channel** menu to select the **Profile/timer** mode. In this mode using the Source parameter user has to select which **Profile/timer** has to be used . There are two methods for configuring Profile/timer: either through a submenu Profile/timer in the Device configuration (see section **Profile/timer**) or directly in the input channel for Profile/timer mode by pressing the button **Configure source**.

Fig. 7.44. View of the input channel configuration in Profile/timer mode

The parameters in the Profile/timer mode are shown in Fig. 7.44.

Details information about the Profiles/timers settings can be found in Chapter 7.11 **PROFILES/TIMERS**.

7.8.7. Examples of Logical Channels configuration

Example 7.8.1: Application of input channel in the Hardware input mode for UI4 modules (see the Appendix 9.1 ui4, ui8, u16, i16 - Voltage and CURENT MEASUREMENT modules) and Math function mode

Lets assume that we can measure only *voltage* and *current* of some heater, but we would like to observe also its power. Using **UI4** (voltage/current measurement module) and external converters it is possible to measure voltage and current higher than basic range of **UI4** module. So lets say that we have connected proper converters and connected measurement signal of current to hardware input **A1**, and voltage signal to input **A7**.

First at all we define 3 **Logical Channels**. Enter **Input Channels** menu and using arrows in **upper navigation bar** select **Logical Channel 20**, set its name to “**Current**”, and **Mode to Hardware input**. Now we can select the source - “**Inp. A1: Current**”. Next press button “**Configure source**” to enter hardware configuration. Set appropriate unit, and limits of input signal, and exit hardware configuration menu.

Then it is necessary to scale input signal, so select **Scaling: linear**, and configure scaling coefficients. Lets say - **Output unit: A** (ampere), **Point 1 - Input value: 0 mA, Output value: 0 A. Point 2 - Input value: 20 mA, Output value: 5 A**. Exit scaling menu.

Default displaying mode is **Numeric** format, and it is proper for this purpose, but precision and data limits should be changed – **Precision: 0.0, Graph Low: 0 A, Graph High: 5.1 A**.

Logical channel 21 should be configured in similar way, but remember about other scaling coefficients, units and limits.

Logical channel 22 has to represent the power emitted by the heater. The power equals to multiplication of voltage and current of the heater, so this channel should be set into **Math function** mode. Other parameters of this mode should be set as follow -

Function: X*Y; Source X: Log. ch. 20:“Current”, Source Y: Log. ch. 21:“Voltage”.

Displaying mode of **Logical channel 22** should be set as for **Logical channel 20** and **Logical channel 21**, preserving their proper graphs limits. We have defined logical channels. Next exit from the menu **Input channels**.

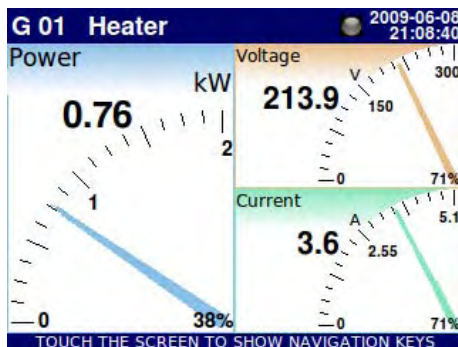


Fig. 7.45. Logical channels configuration - Example 1

To visualise all the data, channels must be added to some group. Using **Configuration menu** enter **Groups** definition submenu, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. “**Heater**”, and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow -

Slot 1: Log. ch. 22:“Power”, Slot 2: Log. ch. 21:“Voltage”, Slot 3: Log. ch. 20:“Current”,

Slot 4: disabled, Slot 5: disabled, Slot 6: disabled.

Next exit the menu pressing **Save changes**, the result should be visible as soon as first measurement is done. Example of screen shot with needles is in Fig. 7.45.

Example 7.8.2: Application of input channel in the **Hardware input mode** for **tc4** modules (see the Appendix 9.2tc4, tc8 – THERMOCOUPLE SENSOR MEASUREMENT modules) and **Math function mode**.

This example show situation that we can measure 4 temperature in the production hale using the thermocouple type K. If the temperature from all sensors exceed value **140°C**, than in the other channel will be visible text -HI-, otherwise case will be visible text -LO-. The result this example must visible in one window.

Firstly we connect sensors according to instruction. Next we define 5 **Logical Channels**. Enter **Device configuration** → **Input Channels** menu and using arrows in **upper navigation bar** select **Logical Channel 1**, set its name to “**Thermocouple A1**”, and **Mode to Hardware input**. Now we can select the source - “**Inp.A1:Thermocouple**”. Next press button “**Configure source**” to enter hardware configuration. Accept the default value i.e.: Mode: **Thermocouple K**, Low limit: **-200°C**, High limit: **1370°C** and exit hardware configuration menu. Processing parameters is left unchanged. Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: -200 °C**, **Graph High: 1370 °C**.

Logical channel 2, 3, 4 should be configured in similar way, but remember about other **name** and **Source** of hardware input. The **logical channel 5** represent alarm condition using in this case **Math function** mode. We set name “**Alarm state**”, Mode: **Math function**. To change the configuration of the function, simply press button next to label **Function**. In the menu **Function** we select function **All X[i]>Y** in the parameter **Function**, **Source X**: Log.ch.1:“**Thermocouple A1**”, Log.ch.2:“**Thermocouple A2**”, Log.ch.3:“**Thermocouple A3**”, Log.ch.4:“**Thermocouple A4**”, **Type of source Y**: value, **Source Y**: **140°C**. Exit from the configuration menu of mathematical function. Due to we do not need any post processing its both parameters can be disabled (Scaling: disabled, Filter type: disabled). Next we define displaying mode as a **Format**: binary, **Off-state text**: we write text -LO- (we can add blue colour in the text editor, see Fig. 7.5), **On-state text**: -HI- (set the colour red) and **Graph Low: 0**, **Graph High: 2**. We have configured 5 logical channels in the **Input channels** menu. Next exit from the menu **Input channels**. To visualise all the data, channels must be added to some group. Using **Configuration** menu enter **Groups** definition submenu, and enable **Group 2 (Group: enabled)**. Then change its name to e.g. “**Temperature**”, and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow - **Slot 1: Log. ch. 1:“Thermocouple A1”**, **Slot 2: Log. ch. 2:“Thermocouple A2”**, **Slot 3: Log. ch. 3:“Thermocouple A3”**, **Slot 4: Log. ch. 4:“Thermocouple A4”**, **Slot 5: Log. ch. 5:“Alarm state”**, **Slot 6: disabled**.

Next exit the menu pressing **Save changes**, the result should be visible as soon as first measurement is done. Example of screen shot with values is in Fig. 7.46.

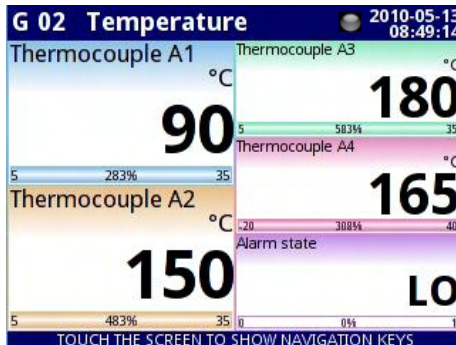


Fig. 7.46. The proposition of the result the Example 2

Example 7.8.3: Application of input channel in the Hardware input mode for RT4 modules (see the Appendix 9.3 rt4 – RTD MEASUREMENT module) and Math function mode.

Having build in **RT4** measurement module, simultaneous monitoring of temperature in 4 points is possible. Lets assume that we have a small house and want to monitor temperature in basement, kitchen, bathroom and outside of the building. For first 2 channels we use PT1000 sensors with 3 wire connection, and for other PT100 with 2 and 4 wire connection.

First of all we have to connect sensors according to module instruction. Next we can configure **Logical Channels**. After entering **Input channels** configuration we can configure 4 **Logical Channels**.

Using arrows in upper navigation bar select **Logical Channel 32**, and set its name “**Bathroom**” and mode: **Hardware input**. Next we can select the source. Assuming that sensor installed in the bathroom is connected to **Physical Input A1** select this input as a source. Next press button **Configure source** to enter hardware configuration. In this panel in the parameter **Mode** select the type of the sensor and connection method **PT1000 3 wire**, next set **Low Limit**: -50°C and **High Limit**: 600°C. Finally exit hardware configuration. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled**, **Filter type: disabled**). Default displaying mode is **Numeric** format, and it is proper for this purpose, but we can change **Precision** and extend it by one digit after decimal point. Also lower and upper ends of graph can be changed. Lets say that temperature in bathroom can vary from 15 to 30 degrees, so we can set such range with e.g. 5 deg of margin. (**Graph low = 10.0**, **Graph high = 35.0**);).

Other logical channels (**34**, **36**, **38**) should be configured in similar way with its name: **Kitchen**, **Basement** and **Outside**, respectively. Finally there are four **Logical Channels** defined. Next exit from the menu **Input channels**. To visualise all the data, channels must be added to some group.

Using **Configuration menu** enter **Groups** definition, and enable **Group 2 (Group: enabled)**. Then change its name to e.g. “**Home**”, and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow -

Slot 1: Log. ch. 32 “Bathroom”, Slot 2: Log. ch. 34 “Kitchen”, Slot 3: empty
Slot 4: Log. ch. 36 “Basement”, Slot 5: Log. ch. 38 “Outside”, Slot 6: empty.

After whole configuration exit the menu pressing **Save changes**, the result should be visible as soon as first measurement is done. Example of screen shot with bars is in Fig. 7.47.

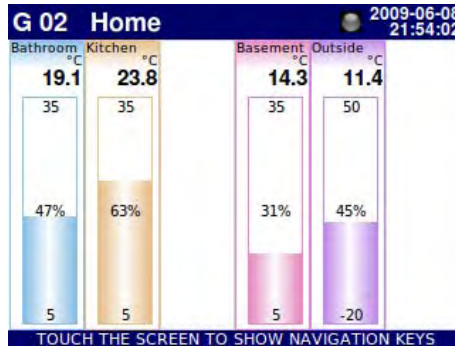


Fig. 7.47. Logical channels configuration - Example 3

Example 7.8.4: Application of input channel in the Hardware output monitor mode for **r45**, **r81** modules (see the Appendix 9.6 **r45**, **r81** - relay modules).

This example consists of reading the value transferred to the output module **r45**.

To can read the values transferred to the output the **CMC-99** should has build-in outputs module e.g. **r45** (except the Sound signal and Virtual relay) and has the logical channel that controls the output signal.

First of all we have to connect output according to module instruction. Next we can configure **Logical Channels**. After entry to **Input channels** configuration we can configure **Logical Channel**. Using arrows in upper navigation bar select **Logical Channel 5**, and set its name "**Relay 1**". Now we can select the source – e.g. "**Out.A1 : Relay**" that we want to monitor. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled**, **Filter type: disabled**). Because the output module **r45** have binary states so we change the Format displaying to **binary**. Accept the default value i.e.: Off-state text: **OFF** and On-state text: **ON** and change data limits: **Graph Low: 0**, **Graph High: 1**. We have defined logical channel. Next exit from the menu **Input channels**. To visualise the data, channel must be added to some group.

Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. "**Output monitor**", and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow - **Slot 1: Log. ch. 5 "Relay 1"**, **Slot 2: disabled**, **Slot 3: disabled**, **Slot 4: disabled**, **Slot 5: disabled**, **Slot 6: disabled**.

After whole configuration exit the menu pressing **Save changes**, the result should be visible as soon as first measurement is done. View the example shown in Fig. 7.47.

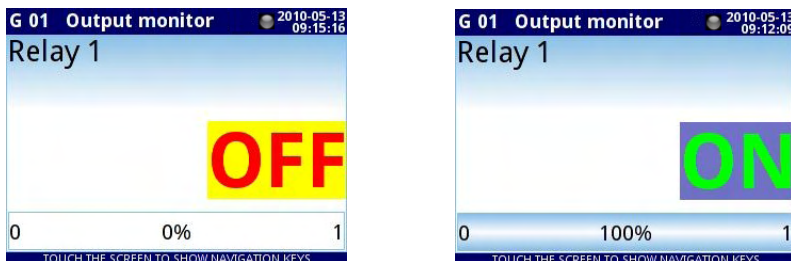


Fig. 7.48. The proposition of the result the Example 4

Example 7.8.5: Application of input channel in the Modbus mode.

Lets assume that we want to measure the temperature by TRS-01a device and want read the temperature via the **CMC-99**. We know that the register that reads the temperature is number 1 and is assigned the first address.

The first step is to configure appropriate parameters for the Modbus (Master) menu (see Chapter 7.14 Modbus and *Example 7.14.1* in Chapter 7.14.1) e.i. baud rate, the definition of SLAVE device, etc. Next we define the **Logic channel** in Modbus mode. After entry to **Input channels** configuration we can configure **Logical Channel**. Using arrows in upper navigation bar select **Logical Channel 1**, and set its name i.e. **“Temperature”**. Then select the appropriate Port (MB1), then select SLAVE device: Addr.1:“Temperature”. In the next step we set parameter **Device input: Inp.1 :HR 1h, b.0-15**. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled, Filter type: disabled**) but we can add a unit going to the **Scaling** submenu and using option **linear**. Press **Configure scaling** button to set the parameter **Output unit**. Default displaying mode is Format: **Numeric**, and precision: **0.0**, it is proper for this purpose, **Graph Low: -50 °C, Graph High: 600 °C**. We have defined logical channel. Next exit from the menu **Input channels**. To visualise the data, channel must be added to some group. Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. **“TRS-01a”**, and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow -

Slot 1: Log. ch. 1 “Temperature”, Slot 2: disabled; Slot 3: disabled; Slot 4: disabled; Slot 5: disabled; Slot 6: disabled.

After whole configuration exit the menu pressing Save changes, the result should be visible as soon as first measurement is done.

Example 7.8.6: Application of input channel in the Math function mode.

In this example we calculate the mean value from logic channels 1, 2, 6, 7, 22, 23, 25 and 30. In these channels are values from thermocouple sensors that are located around the furnace.

Firstly we connect sensors according to instruction (see Appendix 9.2 tc4, tc8 – THERMOCOUPLE SENSOR MEASUREMENT modules). Next we defined **Logical Channels**. We enter to the **Device configuration** → **Input Channels** menu and using arrows in **upper navigation bar** select **Logical Channel 1**, set its name to **“Thermocouple A1”**, and **Mode to Hardware input**. Now we can select the source - **“Inp.A1:Thermocouple”**. Next press button **“Configure source”** to enter hardware configuration. Accept the default value i.e.: Mode: **Thermocouple K**, Low limit: **-200°C**, High limit: **1370°C** and exit the hardware configuration menu. Processing parameters is left unchanged. Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: -200 °C, Graph High: 1370 °C**.

Logical channel 2, 6, 7, 22, 23, 25, 30 should be configured in similar way, but remember about other **name** and **Source** of hardware input.

In the next step we define **Logic channel** for the mathematical function. Using arrows in **upper navigation bar** select **Logic channel 3** and change mode to the **Math function**. Set its name **“Mean”**. Next we enter to the menu **Function** and select in the parameter **Function** the function **Mean X[i]**. Then in the parameter **Source X** select all the channel than we want to calculate the mean value: 1, 2, 6, 7, 22, 23, 25, 30. We select the option **errors forwarded to result** in the **X error handling** parameter because we want to be informed about any alarm state. Due to we do not need any post processing its both parameters can be disabled

(**Scaling: disabled, Filter type: disabled**). Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: 0, Graph High: 300**. We have defined logical channels. Next exit from the menu **Input channels**. To visualise the data, channel must be added to some group. Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. "**Mean**", and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow -

Slot 1: Log. ch. 3 "Mean", Slot 2: disabled; Slot 3: disabled, Slot 4: disabled, Slot 5: disabled; Slot 6: disabled.

After whole configuration exit the menu pressing **Save changes**, the result should be visible as soon as you exit the menu.

Example 7.8.7: Application of input channel in the Math function mode.

This example explain mathematical function **$X[i]$ select by Y**. We create a function that selects a value from among the 4 logical channels depending on channel Y.

Lets assume that we measure the temperature by thermocouple sensor and the result in the four logical channels 1, 2, 3, 4, respectively in the **Hardware input** mode. Logical channel 5 is defined as **Source Y** in the **Set point value** mode. The Logical channel 6 we set in the **Math function** mode.

First, we defined **Logical Channels**. We enter to the **Device configuration** → **Input Channels** menu and using arrows in **upper navigation bar** select **Logical Channel 1**, set its name to "**Value 1**", and **Mode to Hardware input**. Now we can select the source - "**Inp.A1:Thermocouple**". Next press button "**Configure source**" to enter hardware configuration. Accept the default value i.e.: Mode: **Thermocouple K**, Low limit: **-200°C**, High limit: **1370°C** and exit hardware configuration menu. Processing parameters is left unchanged. The **Displaying** parameters for this channel are not important because we want to display only channel with a mathematical function.

Logical channel 2, 3, 4 should be configured in similar way, but remember about other **names** and **sources**.

Logical channel 5 defines **Source Y** in mathematical function. using arrows in **upper navigation bar** select **Logical Channel 5**, set its name to "**Source Y**", and **Mode to Set point value**. The parameter **Unit** sets empty and in the **Set point value** parameter we enter the value in the range of 0 to 5. The **Displaying** parameters for this channel are not important because we want to display only channel with a mathematical function.

After configuration channels for **sensors** and **Set point values** mode we define a channel with a mathematical function.

Using arrows in **upper navigation bar** select **Logical Channel 6**, set its name to "**Math function**", and Mode to **Math function**. To change the configuration of the function, simply press button next to label **Function**. In the menu **Function** we select function **All $X[i]>Y$** in the parameter **Function**, **Source X**: Log.ch.1:"Value 1", Log.ch.2:"Value 2", Log.ch.3:"Value 3", Log.ch.4:"Value4", **Source Y**: select the logical channel 5. Exit from the configuration menu of mathematical function. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled, Filter type: disabled**). Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: 0 °C, Graph High: 100**. Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. "**Select the channel**", and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow -

Slot 1: Log. ch. 6 "Math function", Slot 2: Log. ch. 5 "Source Y", Slot 3: disabled, Slot 4:

disabled, Slot 5: disabled; Slot 6: disabled.

After whole configuration exit the menu pressing Save changes, the result should be visible as soon as you exit the menu. The results of this mathematical function is shown in the table below.

The value of the source Y	Result
≤ 0	The value of the channel 1
$(0,1>$	The value of the channel 2
$(1,2>$	The value of the channel 3
>2	The value of the channel 4

Example 7.8.8: Application of input channel in the Controller mode.

The example is the temperature control that sets point is value of the Logical channel (constant value 85°C) and the feedback signal come from the sensor Pt100.

The first step is to configure appropriate parameters for the Controllers menu (sets first Controller its name to "**Controller 1**", see Chapter 7.12 Controllers and Example 7.12.1 to know how to do it).

Next we defined **Logical Channels**. We enter to the **Device configuration** → **Input Channels** menu and using arrows in **upper navigation bar** select **Logical Channel 1**, set its name to "**Value**", and **Mode** to **Set point value**. The parameter **Unit** sets **°C** and in the **Set point value** parameter we enter a value of **85°C**. Default displaying mode is Format: **Numeric**, and precision: **0**, **Graph Low: 0**, **Graph High: 300**. Next we defined the **Logical channel 2** sets in the **Hardware input** mode and name: "**Sensor**". Assuming that sensor is connected to **Physical Input A1** select this channel as a source. Next press button **Configure source** to enter hardware configuration: we select **Pt100** mode and Low Limit: **-50°C** High Limit: **600°C**. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled**, **Filter type: disabled**). Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: 0**, **Graph High: 300**. The **Logical channel 3** sets in the **Controller** mode, and name "**Controller**". We set unit: **mA**. The parameter **Controller number** we set the **Controller 1** to defined before, a parameter **Set point channel** we select **Logical channel 1** and parameter **Feedback channel** select **Logical channel 2**. Default displaying mode is Format: **Numeric**, and precision: **0.0** and it is proper for this purpose, **Graph Low: 0 °C**, **Graph High: 20**. We have defined logical channels. Next exit from the menu **Input channels**. To visualise the data, channels must be added to some group. Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. "**The temperature control**", and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow - **Slot 1: Log. ch. 3 "Controller"**, **Slot 2: Log. ch. 1 "Value"**, **Slot 3: Log. ch. 2 "Sensor"**, **Slot 4: disabled**, **Slot 5: disabled**, **Slot 6: disabled**.

After whole configuration exit the menu pressing Save changes, the result should be visible as soon as first measurement is done.

Example 7.8.9: Application of input channel in the Profile/timer mode.

Create the Profile/timer in the logical channel 1 in the edge (once) triggering mode. Trigger source is logical channel 2 is connected to hardware input from voltage/current module UI4. Profile consists of 4 sections: 1. ramp from 0 to 10 in 5 seconds, 2. constant value 8 in 2 seconds, 3. ramp from 8 to 4 in 3 seconds and 4. constant value 4 in 1 seconds. Idle value is 0 and looping is disabled.

We enter to the **Device configuration** → **Input Channels** menu and using arrows in upper navigation bar select **Logical Channel 1** and set its mode to **Hardware input** and name **"Triggering"**. Next we can select the current source **Physical Input A1**. - **"Inp. A1: Current"**. Next press button **"Configure source"** to enter hardware configuration. Set mode: Current 0-20mA, Low limit: 0mA, High limit: 20mA and exit hardware configuration menu. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled, Filter type: disabled**). Default displaying mode is **Numeric** format, and it is proper for this purpose, but precision and data limits should be changed – **Precision: 0.0, Graph Low: 0 mA, Graph High: 20 mA**. In the next step we define Profile/timer. There are two methods to configure Profiles/timers, first in the **Profiles/timers menu** (see Chapter 7.11 PROFILES/TIMERS and Example 7.11.1) and second in the **Logical channel** in the **Profile/timer** mode. We choose a second method. Using arrows in upper navigation bar select the **Logical channel 2** and select the **Profile/timer** mode and as source select not yet defined **Profile 1**. Sets its name **"Profile 1"** We enter **Configure source** and select **edge (once)** in the parameter **Triggering mode**. In the parameter **Triggering source** we select Logical channel 1 **"Triggering"**. **Idle value** sets to 0, the parameter **Looping** as a disabled. We go to **Section list** menu by pressing the button. In the menu the mark '+' means adding new section and mark '-' - delete selected a section. In the block of parameters: **Duration, Shape and Final value** we set appropriate values is defined above e.g. first section: **Duration 5s, Shape: ramp and Final value: 10**. Exit from the configuration source. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled, Filter type: disabled**). Default displaying mode is Format: **Numeric**, and precision: **0, Graph Low: 0 °C, Graph High: 20**.

We have defined logical channel. Next exit from the menu **Input channels**. To visualise the data, channel must be added to some group.

Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. **"User Profile"**, and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow - **Slot 1: Log. ch. 1 "Triggerin", Slot 2: Log. ch. 2 "Profile 1"; Slot 3: disabled, Slot 4: disabled, Slot 5: disabled; Slot 6: disabled**.


After whole configuration exit the menu pressing Save changes, the result should be visible as soon as first measurement is done.

7.9. BUILT-IN OUTPUTS

This menu is related directly to outputs available in the current hardware configuration. Basic configuration contains **Sound signal** output (buzzer) and 16 **Virtual relays**. Virtual relays were implemented to allow construction of simple logical operations on the input data without involving physical outputs. If any output modules are installed into the device then list of available outputs is lengthened. View of main settings panel related to outputs is in figure 7.49. Parameter **Source** defines the source of data for output controlling, and parameter **Alarm state** defines the state of output in case of alarm state in source channel. If channel is disabled, then no additional parameters are visible, other modes cause displaying of two

groups of parameters specific to particular modes: **Levels** (Fig. 7.50) and **Timing** (Fig. 7.51).

Using arrows located in upper bar user can switch between successive outputs for configuration. Use of middle button with a number allows to jump directly to required channel.

 To check list of build in modules enter **Device information** panel, and read description of slots.

State of physical outputs can be used as source for **Logical Channels** (for details see paragraph **Input channels**)

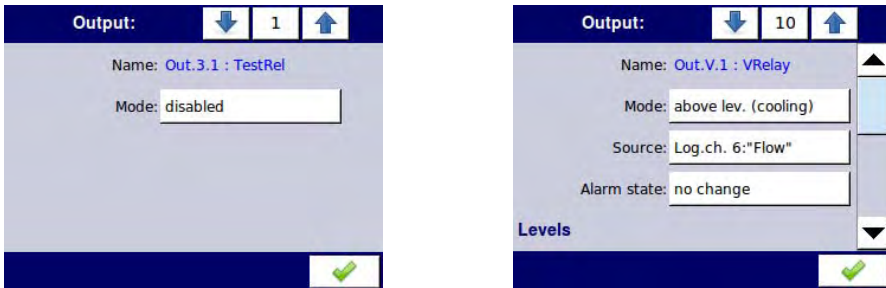


Fig. 7.49. Main settings of disabled (left) and enabled (right) output

7.9.1. Output Mode specific parameters

Every output can be switched to one of 5 modes (disabled, above level, below level, inside range and outside range). Left side of Fig. 7.50 shows parameters related to single threshold of modes "above level" and "below level". Right side for windows in modes "inside range" and "outside range". In Fig. 7.51, common for all modes, timing parameters are presented.

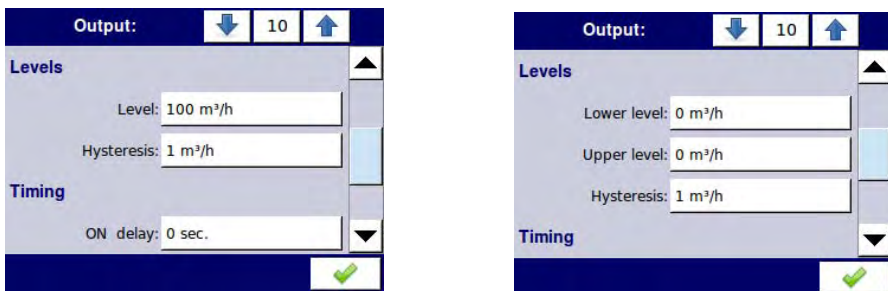


Fig. 7.50. Configuration of Levels for different modes

Fig. 7.51. Configuration of timing for different modes

7.9.2. Output Mode specific parameters for Passive current output

To enable particular output enter Main menu -> Build-in outputs, and select an output to be set, then a menu showed below appears.

Fig. 7.52. Menu of the Passive current output

Visible in Fig. 7.52 fields **Name** and **Unit** are fixed by software and type of hardware build-in output features. Field **Source** defines the *Logical channel* used to control current output value. Data from this source is recalculated according to parameters gathered into two groups: **Input levels** and **Output levels**.

Data entered as „**Input levels**” has the same unit as selected *Logical channel* (in picture above *Logical Channels 1* has no unit), and data in group „**Output levels**” has unit depending on particular output type (for current output „mA”). This four coefficients describe transmission equation (linear). In other words: **Output Lower level** defines what current should be generated when selected channel value equals **Input Lower level**, and **Output Upper level** defines current generated when input equals **Input Upper level**. If user set data as in picture above then output directly generates current equal to input value. Parameter „**Alarm level**” defines current generated when selected source generates any error value (e.g. there is no data, or result exceeds permissible measurement range).

Fig. 7.53. Other parameters of the Passive current output

7.9.3. Examples of build-in output configurations

Example 7.9.1: Application of the output for r45, r81 modules (see Appendix 9.6 r45, r81 - relay modules).

Let's say that we would like to control temperature in some room by switching ON and OFF an electric heater. The temperature be measured using PT-100 sensor and **RT4** input module, and let the heater be controlled using internal 5A relay (**R45** module).

To realize such task it is necessary to define at least one **Logical channel**. First, we defined **Logical Channels**. We enter to the **Device configuration** → **Input Channels** menu and using arrows in upper navigation bar select **Logical Channel 1**, and set its name **"Temperature"** and mode: **Hardware input**. Next we can select the source. Assuming that sensor installed in the room is connected to **Physical Input A1** select this input as a source. Next press button **Configure source** to enter hardware configuration. In this panel in the parameter **Mode** select the type of the sensor and connection method **PT100**, next set **Low Limit**: -50°C and **High Limit**: 600°C. Finally exit hardware configuration. Due to we do not need any post processing its both parameters can be disabled (**Scaling: disabled, Filter type: disabled**). Default displaying mode is **Numeric** format, and it is proper for this purpose, but we can change **Precision** and extend it by one digit after decimal point. Also lower and upper ends of graph can be changed. Lets say that temperature in the room can vary from 18 to 27 degrees, so we can set such range with e.g. 3 deg of margin. (**Graph low = 15.0, Graph high = 30.0**;) We have defined logical channel. Next exit from the menu **Input channels**.

Then we define hardware output. We enter to the **Device configuration** → **Build-in outputs** menu and using arrows or pressing middle button with a number in upper navigation bar select **Output 1**. Then switch its mode to **"below level" (heating)**, and define source of input data as follows **Source: Log. ch. 1 "Temperature"**. Select the Alarm state: **immed.OFF** which will switch off the heater when the sensor is damaged. Finally define desired **Level** of switching - 23, and the **Hysteresis** - 2. To prevent relay against often switching it is possible and set minimal ON and OFF times and delays. Save the changes to finish the configuration. From this moment **Relay C1** will be switched ON when temperature in controlled room drop below assumed level (minus **Hysteresis**) and OFF when temperature is higher then this level plus **Hysteresis**.

Example 7.9.2: Application of output for IO2, IO4 modules (see the Appendix 9.7 IO2, IO4 – PASSIVE CURRENT OUTPUT).

Assume that **Logical Channel 1** indicates pressure in range 100 – 500 bars, and its result should be regenerated to current output in corresponding range „4-20mA”.

We enter to the **Device configuration** → **Build-in outputs** menu and using arrows or pressing middle button with a number in upper navigation bar select output you want to use e.g. **Output 1**. Next set: **Source:** *Logical Channel 1*, (then unit of **Input Levels** will be changed automatically to "bar"), **Input Lower level:** 100 bar, **Input Upper level:** 500 bar, **Output Lower level:** 4 mA, **Output Upper level:** 20 mA, **Alarm Level:** 3.5mA

Due to fact that output is passive type, it is required to power the current loop. Schematic is shown in the Fig. 9.7. Note that polarisation of IO2 and IO4 outputs has no matter.

7.10. EXTERNAL OUTPUTS

This menu is related to the send data using Modbus communication protocol from the **CMC-99** to SLAVE device. Here it is determined what will be send to other device while the configuration for Modbus Master mode (for example baud rate, active output register list and etc.) can be found in the Modbus menu (see Chapter 7.14 Modbus). In the absence of active or configured on the Modbus outputs in External output menu reads "*The list is empty*". View the External output menu when is active and configured created for 2 types of control: as a relay (binary) or as a linear output (analog) is shown in Fig. 7.54.

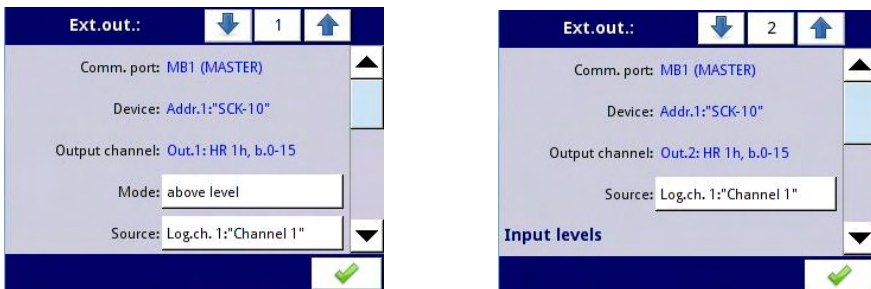


Fig. 7.54. View the external output in two types: as a relay and a linear output

Using arrows located in upper bar user can switch between successive external outputs for configuration. Use of middle button with a number allows to jump directly to required output. To recognize external output is visible a description (blue colour) **Communication port**, **Device** and **Output channel**. Further parameters are dependent on the type of control. For the linear output the next parameter is the **Source** which indicates the source of data destination for transmission. The next block of parameters is **Input levels** and **Output levels**. Input levels limited range of data input while output levels scaling this data. **Alarm level** parameter set selected value in alarm situation for example if are exceeded the upper and lower limit of measuring range or if the sensor is damaged. For Modbus output configured as a relay type of control the first parameter is **Mode**. If the **Mode** is set to inactive than the additional parameters are not visible, other modes cause displaying of two groups of

parameters specific to particular modes: **Levels** (Fig. 7.50) and **Timing** (Fig. 7.51). Parameter **Source** defines the source of data for output controlling, and parameter **Alarm state** defines the state of output in case of alarm state in source channel.

7.10.1.Examples of external output configurations

Example 7.10.1: Application of external output for protocol Modbus in the MASTER mode.

Lets assume that we want to send the date to TRS-10a (the indicator) by protocol Modbus. We know the address (address 5) of the SLAVE device and a registry number (register 1).

The first step is to configure appropriate parameters for the Modbus (Master) menu (see Chapter 7.14 Modbus and Example 7.14.2) i.e. baud rate, the definition of SLAVE device (the output must be a linear type), etc. Next we define the **Logic channel**. After entry to **Input channels** configuration we can configure **Logical Channel** using arrows or pressing middle button with a number in upper navigation bar select **Logical Channel 1**. Sets its name to **"Date"**, and **Mode to Set point value**. The parameter **Unit** sets empty and in the **Set point value** parameter we enter the value e.g. **"10"**. Default displaying mode is Format: **Numeric**, and precision: **0**, Graph Low: **0**, Graph High: **300**. Next exit from **Input channels** menu and go to the **External outputs** menu.

Using arrows or pressing middle button with a number in upper navigation bar select External output that you want to define – search Comm. Port MB1 (MASTER), Device: Addr.5:"TRS-10a", Output channel: Out.1:HR 1h,b.0-15. Next we select source Log.ch. 1:"Date". Than we set Input levels. Because in the Logical channel 1 we set displaying range of 0 to 300 than in the **Input levels** we set parameters: **Lower level**: 0 and **Upper level**: 300. Due to we want linear output without scaling than we set **Output levels**: **Lower level** 0 and **Upper level** 300. **Alarm level** we set to 0.

After whole configuration exit the menu pressing Save changes, the result should be visible as soon as you exit the menu.

7.11. PROFILES/TIMERS

Profiles/timers were created to generate signals defined by the user. The View of the configuration window is shown in Fig. 7.55.

Profile/timer:	
Name:	Profile 1
Triggering mode:	edge (once)
Triggering source:	Log.ch. 1:"Channel 1"
Idle values:	1
Section list	

Fig. 7.55. View of the configuration Profiles/timers window

Using arrows located in upper bar user can switch between successive Profiles/timers for configuration. Use of middle button with a number allows to jump directly to required Profile/timer. The basic parameters are **Name**, **Idle value**, that is set after execution profile/timer, **Section list** in which the user can define the signal consist maximal 100 sections, using **Duration**, **Shape** of signal (constant value or ramp) and **Final value** of section. Parameter **Looping** has 3 options to choose: **disabled**, **counted** and **Infinite**. Parameter **Return to position** allows you to select the starting position the next repetition of a defined profile/timer. Other parameters are variable depending on the **Triggering mode** parameter: **Triggering source** and **Triggering times**. Profiles/timers may occur in the five trigger modes: **disabled**, **level (gate)**, **edge (once)**, **edge (retrig.)** and **on time**. **Disabled** means that the Profile/timer on this number is off. **Level (gate)** means that configured by the user process will be triggered by a level higher than zero. **Edge (once)** means that after the triggering of the increasing edge of the profile executes the entire profile regardless of the frequency of the signal triggering. However, option trigger **edge (retrig)** means that this profile will be generate from the start of each incoming trigger source regardless of whether the profile has been finished or not. User-defined waveforms in the above-described modes are activated **Triggering Source** parameter. Last possible to choose the mode: on **time** set the signal starts with the **Triggering times** parameter. View of the configuration for parameter **on time** is shown in Fig. 7.56.

Fig. 7.56. View of the configuration on **time**

Use this parameter with an accuracy of one second, we can set time to generate the specified profile/timer. Options allow you to generate a recurring run at a specified time period, which can be programmed so that such course of generate in the month of March and June from 3 to 24 on weekdays at 7.00 to 15.00, every minute every 30 seconds. To change it, simply press button next to label **Name**. When near to any parameters in **triggering times** menu will be marking '----' this means is that no option is selected and the output signal does not appear even set other parameters. Generation signal in **on time** mode is similar to the edge (once) - mode, i.e. after the triggering time of generating signal executes the entire defined signal regardless of the frequency of the time triggering.

7.11.1. Examples of Profile/timer configurations

Example 7.11.1: Application of the Profiles/timers.

This example describe the way to create the Profile in the logical channel 1 in **level (gate)** **trigger** mode. Triggering source of the Profile is the logical channel 2, which is set to hardware

input – i.e. current input A1 (UI4). The Profile consists of 4 sections: 1. ramp from 0 to 10 in 5 seconds, 2. constant value 8 in 2 seconds, 3. ramp from 8 to 4 in 3 seconds and 4. constant value 4 in 1 seconds. Idle value is 0 and the loop is disabled.

There are two methods to configure Profiles/timers, first in the **Profiles/timers menu** and second in the **Logical channel** in the **Profile/timer mode**. In this case presents the first method. We enter to the **Device configuration** → **Profiles/timers** menu and using *arrows* or pressing middle button with a number in *upper navigation bar* select **Profile/timer 1**. Next we can change the name to **"My Profile"**. We select **level (gate)** in the parameter **Triggering mode**. In the parameter **Triggering source** we select **Logical channel 1 "Triggering"** which be defined later. **Idle value** sets to 0, the parameter **Looping** as a disabled. We go to **Section list** menu by pressing the button. In the menu the mark '+' means adding new section and mark '-' - delete selected a section. In the block of parameters: **Duration**, **Shape** and **Final value** we set appropriate values as defined above e.g. first section: **Duration** 5s, **Shape**: ramp and **Final value**: 10. Exit from the configuration source.

In the next point enter **Input channels** menu and define **logical channel** in the **Profile/timer** mode and select the Profile (**"My Profile"**) that is configured above. Finally, after defining the Logical channel and add to the Group the result should be visible in the display.

The second method is described in section 7.8.7 Examples of Logical Channels configuration in the *Example 7.8.9*

7.12. CONTROLLERS

Although most controlling processes can be realised using simple ON - OFF mode, there is sometimes necessity of application of more advanced way of driving the actuators. Designers of **CMC-99** implemented 5 PID controllers profiles which can be used by any *Logical Channel* switched in *Controller* mode. In the system is available 8 controllers.

Using arrows located in upper bar user can switch between successive Controllers for configuration. Use of middle button with a number allows to jump directly to required Controller.

Fig. 7.57. Main configuration of an Controller profile

Every controller profile can be set in one of three modes: PD (proportional-differentiate), PI (proportional-integrate), PID (proportional-integrate-differentiate). Selection of desired **Mode** enables presentation of appropriate **coefficients** - P, I, D and also selection of **differentiated signal** while PD and PID mode (see Fig. 7.58).

Dead zone parameter determines how much different between previous and current process value to starting generate the controlled signal.

Parameter **Differentiated signal** has 2 options: **feedback (measured)** and **error (deviation)**. Feedback (measured) option which is also the default option we use when to feedback channel (see section **7.8.5 Input Channels settings for Controller mode**) we connect the signal from detector. In this case **CMC-99** can automatic computing the error signal (deviation) and generate control signal, respectively. When using options error (deviation) than to the feedback channel is give converted off-set of measurement and control devices **CMC-99** set on the basis of the output signal.

Controller: 3

Controller parameters

P coefficient: 5

I coefficient: 0.01 sec.

D coefficient: 0.005 sec.

Differentiated signal: feedback (measured)

Fig. 7.58. Configuration panel of Controller parameters

The set of **Controller's output** parameters are independent on selected type of Controller – see figure 7.59. Values in fields: **Offset**, **Low output limit**, **High output limit** are expressed with unit entered in field **Output unit**. Changes of this parameter causes changes in all three boxes. Parameters **Low output limit** and **High output limit** set a range of the control signal.

Controller: 1

Controller output

Output unit: m/sec.

Offset: 0 m/sec.

Low output limit: 0 m/sec.

High output limit: 0 m/sec.

Fig. 7.59. Controller output configuration parameters

7.12.1. Examples of Controller configurations

Example 7.12.1: Application of the Controllers (see Chapter 7.12 Controllers for more information about the parameters of Controllers)

Lets assume that we want to configure Controller in the PID mode which controls temperature in the room. The signal from temperature sensor PT100 is connected to Logical channel 1. The **Controller** controls the passive current output generating a signal in the range of 4 to 12mA to control the heater.

We enter to the **Device configuration** → **Controllers** menu and using arrows in upper navigation bar select **Controller 1**. Next we set the name e.g. "**Controller**". In the parameter **Mode** we select **PID**. **Dead zone** parameter we set to 0. Next we set the **Controller parameters** block as follows – **P coefficient**: 0.8, **I coefficient**: 0.1, **D coefficient**: 0.05, **Differentiated signal** we select the **feedback (measured)**. However, the **Controller output** block of parameters we set as follows: **Output unit**: mA, Offset: 0, **Low output limit**: 4mA, **High output limit**: 12mA. Exit from the **Controllers** menu.

In the next point enter **Input channels** menu and define **Logical channel 1** using arrows in upper navigation bar, and select **Set point value mode**. Parameter **Name** set to "**Set point**", parameter **Unit** set to °C and in the **Set point value** parameter we enter the value 23. Default displaying mode is **Numeric** format, and it is proper for this purpose, but precision and data limits should be changed – **Precision**: 0.0, **Graph Low**: 15 °C, **Graph High**: 30 °C.

Next we define **Logical channel 2** by setting name "**Room**" and mode: **Hardware input**. Next we can select the source. Assuming that sensor installed in the room is connected to **Physical Input A1** select this input as a source. Next press button **Configure source** to enter hardware configuration. In this panel in the parameter **Mode** select the type of the sensor and connection method **PT100**, next set **Low Limit**: -50°C and **High Limit**: 600°C. Finally exit hardware configuration. Due to we do not need any post processing its both parameters can be disabled (**Scaling**: disabled, **Filter type**: disabled). Default displaying mode is **Numeric** format, and it is proper for this purpose, but we can change **Precision** and extend it by one digit after decimal point. Also lower and upper ends of graph can be changed. Lets say that temperature in room can vary from 15 to 25 degrees, so we can set such range with e.g. 5 deg of margin. (**Graph low** = 10.0, **Graph high** = 30.0).

In the next point define **Logical channel 3** by setting name "**Controller**" and mode: **Controller**. We set **Unit** parameter to mA. In the **Controller num.** parameter select the Controller 1 (1.PID:"Controller"). In the **Set point channel** parameter we set **Logical channel 1**, **Feedback channel** parameter we set to **Logical channel 2**. In the Displaying block of parameters we set **Numeric** format, change **Precision** extend it by one digit after decimal point. We set Graph low: 0 and Graph high to 20.

To control the temperature in the room we need to connect the signal from the controller to appropriate output control e.g. heating. For this purpose we use the Passive current output.

We enter to the **Device configuration** → **Build-in outputs** menu and using arrows or pressing middle button with a number in upper navigation bar select output you want to use e.g. **Output 1**. Next set: **Source**: Logical Channel 3, (then unit of **Input Levels** will be changed automatically to "mA"), **Input Lower level**: 4 mA, **Input Upper level**: 12 mA, **Output Lower level**: 4 mA, **Output Upper level**: 12 mA, **Alarm Level**: 4 mA.

We have defined logical channel and build-in output. To visualise the data, channel must be added to some group.

Using **Configuration menu** enter **Groups** definition, and enable **Group 1 (Group: enabled)**. Then change its name to e.g. "**Temperature controller**", and select sources of data to be presented. To do this move window over parameters called **Channels** and set them as follow - **Slot 1**: Log. ch. 1 "**Set point**", **Slot 2**: Log. ch. 2 "**Room**", **Slot 3**: Log. ch. 3 "**Controller**", **Slot 4**: empty, **Slot 5**: empty, **Slot 6**: empty.

After whole configuration exit the menu pressing Save changes, the result should be visible as soon as first measurement is done.

Due to fact that output is passive type, it is required to power the current loop. Schematic is shown in the Fig. 9.7. Note that polarisation of IO2 and IO4 outputs has no matter.

7.13. GROUPS

As it was mentioned **Groups** are the sets of 1-6 **Logical Channels** collected together for clearance. To see detailed definition of **Group** see **Introduction to MultiCon**.

7.13.1. Groups configuration

Every group can be obviously disabled or enabled. When **disabled** then no other parameters for configuration are available. **Enabled** group has a lot of parameters to make it characteristic and easy for identification. Parameters are gathered into three sets – one related to all **Logical Channels** visible in a **Group**, and second related to main appearance of the **Group** and third related to logging date into **Group**.

Fig. 7.60 shows main parameters of the Group – individual **Name**, orientation of displayed **Bars** and **Charts**, and also **Line width**, **Time Scale** and **Background** colour of the charts. These parameters are related to all visible channels.

Fig. 7.60. Group configuration panel – main parameters

To allow configuration of **Logical Channel** position and size of their data panels a visualisation slots were predefined. Fig. 7.61 shows sight of **Channels** configuration for a **Groups**. Positions of particular “slots” are fixed, but by disabling and enabling neighbouring slots it is possible to change size and position (in some range) of desired “slot”. Using this method user can get many different visualisation modes.

Fig. 7.61. Group configuration panel – **Channels** (visualisation slots) configuration

The **Logging options** block parameters is demonstrate in the Fig. 7.62. Parameter Mode

allow to choose if we want to logging or not, or option always logging or a logging triggering by channel in the **Triggering source** parameter. **Description** parameter allows to describe the logging, **Record period** parameter through parameter **Unit** sets how much per second, minute, hour is repeat login of date. Alternative source allow choose other sets of logging configuration when user wants to set additional advanced options of the logging.

Fig. 7.62. The Logging options block parameters

7.13.2. Examples of visualisations of groups

Example 7.13.1: Single channel - one big needle.

If user needs to visualise single hardware input value it is necessary to define one **Logical channel** and one **Group** with one active channel. Moreover to show incoming data as a single big needle (Fig. 7.63) it is necessary to disable all unused visualisation slots in a **Group**. Of course other presentation modes are also available, to switch between modes use **[MODE]** buttons in **Navigation bar**.

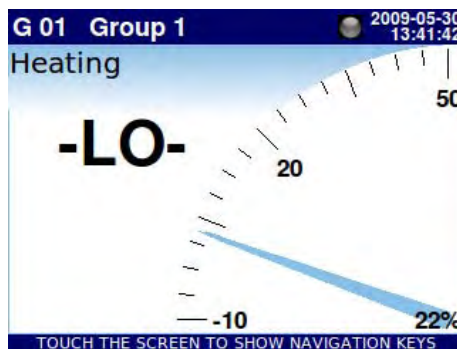


Fig. 7.63. Single big needle example

Example 7.13.2: Three channels view - one bigger, two smaller

If some measured parameters are more important then other there are some ways to

emphasis them. Lets assume then the pressure in some chamber is key parameter, and temperature and humidity are less important. The process of **CMC-99** configuration starts with definition of 3 **Logical Channels** – one for every parameter. Their sources should be in this example a **Hardware inputs** with appropriate scaling and definition of units. Defined channels should be collected into one group. The key matter for desired presentation is configuration of slots sources in the group.

Example view of assumed problem is showed in Fig. 7.64. To get such result slots of the group should be set as follow:

- Slot 1:** Log. ch. 7 “Pressure”;
- Slot 2:** disabled;
- Slot 3:** disabled;
- Slot 4:** Log. ch. 9 “Temperature”;
- Slot 5:** Log. ch. 1 “Humidity”;
- Slot 6:** disabled.

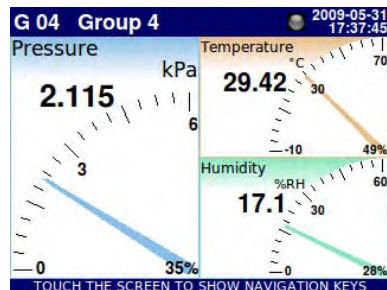
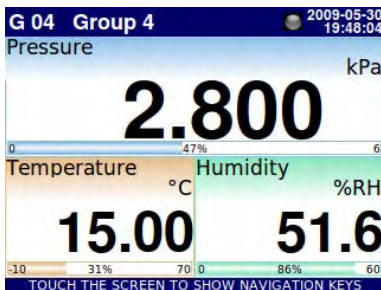


Fig. 7.64. Example of three channels presentation with emphasis of Pressure

Switching between modes it is noticeable that position of particular channels can slightly vary. It is caused by aspect of different modes – their position is selected in that way to obtain elements of particular data panels as big as possible.

7.14. MODBUS

Basic version of **CMC-99** has build in one RS-485 communication port. In the most expanded versions as much as 3 serial ports are available These interfaces can be configure to fulfil user requirements. For today only MODBUS RTU protocol is available, and device can operate as **SLAVE** to be read by some Host. Configuration panel for Modbus is presented in Fig. 7.65.

SLAVE mode has two parameters, Baud rate and address of the device. Master mode configuration is shown in Fig. 7.66.

Fig. 7.65. Configuration parameters for **SLAVE** mode

Fig. 7.66. Configuration parameters for **Modbus** mode

For Master mode parameters are: **Baud rate**, **Request timeout**, **Request retrials**, **Slave devices** and **Numbers of registers**, where by choosing one of these options in **hex** (addition the letter 'h' to a number of register) / **decimal**, we can change the visualization of register number which be shown in the input and output channel for a better and faster localization the SLAVE device.

Slave devices menu has parameters: Device type, Device name, and three groups of parameters: a group of Device templates, consisting of Load device template and Save device template, a group of Device channels with the parameters List of input and output and a group of Register block consisting of a parameter **Blocks configuration mode**, maximum block size and **Block list**. All these parameters are shown in Fig. 7.67.

Using arrows located in upper bar user can switch between successive Modbus address for configuration. Use of middle button with a number allows to jump directly to required address.

Fig. 7.67. Configuration parameters for Slave device menu

Load device template parameter allows you to download the configuration settings file ready I / O SLAVE devices and a list of blocks, and **Save device template** parameter stores the user-defined configuration settings for I / O SLAVE devices and a list of blocks. Template edition panel is shown in the Fig. 7.68.

Template Name	Size	Date
SCK-10	13358 B	2010-05-26 09:38:21
SIA-8	17291 B	2010-02-19 09:45:01
SP-2	8534 B	2010-02-19 09:45:01
TRS-01a	13358 B	2010-05-26 09:37:46
TRS-02a	13358 B	2010-05-26 09:48:35
TRS-11a	13358 B	2010-05-26 09:47:44

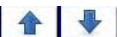
Fig. 7.68. Template edition panel



This button invokes software keyboard window allowing write or search the template name.



This button allow to delete selected template.



Navigation keys allow select appropriate template.

Menu parameter **Input list** the SLAVE device is presented in Fig. 7.69.

Fig. 7.69. View of the Input list menu

Input list consists of five groups of parameters: **Channel value**, **Channel status \'-HI-\'**, **Channel Status \', LO-\'**, **Channel Status \'-WAIT-\'**, **Channel Status \'-ERR-\'**. Value register menu of Channel value group of parameters is shown in Fig. 7.70.

Fig. 7.70. View of the Register value parameter

For this menu, we have parameters: **Register type** (default HOLDING), **Register number** slaves device, **Data format** depending on the register (if you choose the option the 32 bits that extracts an additional parameter of how to obtain this length of words or as two 16-bit registers or maybe as one 32-bit). We also have the opportunity to change the order of bytes transferred, shift of data and the imposition of the mask data. The next parameter is **Decimal point** which allow to set a constant value or use the **Point register**. Configuration the parameter of Point register is similar to Register value. When we want to SLAVE device alert us of transmission errors and, if such a device has the ability to analyze error, then we can take of the 4 groups that read the parameters of the status register -HI-, -LO-, -WAIT-, -ERR-. To set up such a signal about the state of errors, respectively set three parameters: **State** which can be an option **never** then it is turned off, **if register = value**, or **if register ≠ value**.

When you want masked status register value is equal to or different from the constant value, the parameter register for alarm signal where we choose the masked of status register and the masked **value** parameter for the alarm signal.

Output list is shown in Fig. 7.72.

The screenshot shows a configuration menu for an output channel. At the top, 'Output chan.number:' is set to 1, with up and down arrow buttons. Below this, 'Output active:' is set to 'yes'. The 'Channel value' section shows 'Control type:' as 'as a linear output' and 'Output registers:' as 'HR 1h, b.0-15'. At the bottom, there are three buttons: a green plus sign, a red minus sign, and a green checkmark.

Fig. 7.71. View of the Output list menu

To output was visible on the outside, this should be activated by the output parameter **Output active**. Output can be generate of two types – **Control type: as a relay** or **as a linear output**. The third parameter is the **Output register**, which the menu is presented in Fig. 7.72

The screenshot shows a configuration menu for a register output parameter. The title is 'HR 1h/+1, b.0-31'. The parameters are: 'Register numbers:' set to '1h', 'Data format:' set to '32 bits, signed', '32-bit readings:' set to 'two 16-bit registers', 'Ordering:' set to 'ABCD (standard)', and 'Data mask:' set to '0xFFFFFFFF'. On the right side, there are up and down arrow buttons. At the bottom right, there is a green checkmark button.

Fig. 7.72. View of the Register output parameter

The parameters of **Output register** are the similar as the **Input register**. The last block of parameters for the **SLAVE device** is the **Register blocks**, which depending on the configuration blocks mode can be 2 or 3 parameters. The default configuration mode is automatic mode which, by the parameter **Maximal block size** automatically configures optimal list of blocks for the inputs and outputs configuration. In this mode the parameter **Block list** is only for to browse the available blocks, you can not change anything. When you choose manual configuration mode, the user must configure the **block list** from a input and output list. Menu of **block list** is shown in Fig. 7.73. Menu **Block list** has 4 parameters: **Block type** we set the block to read or write registers, **Registers size** parameter defines the size of the two registers: 16 and 32-bit, parameters **First** and the **Last register** determine the queue reading and write writing registers.




Block number:	↓	1	↑
Block type:	read HOLDING reg.		
Register size:	16-bit registers		
First register:	1h		
Last register:	1h		
<div>    </div>			

Fig. 7.73. View of the Block list parameter

7.14.1. Examples of Modbus protocol configurations

Example 7.14.1: Configuration of the Modbus Input in the MASTER mode.

In this example we show how to configure the **Input channel** of SLAVE device, e.g. for TRS-04a device with **address 3**. We read the **Register 1**, **Register 5** is the **Decimal point register**, **Register 2** is the **Status register** which the value of 80h means that the temperature measurement exceeds the 85°C.

In the first step we enter the **Modbus** → **SLAVE device** menu. We select by using arrows in upper navigation bar the appropriate **address** of SLAVE device (**address 3**). **Device type** parameter we set to **defined** or we can use predefined template with available settings for TRS-04a device by pressing **Load device templates** button. In this example we use first case when the SLAVE device is defined by user. Next we go to the block parameters **Device channel** and pressing the **Input list** button. In the **Input list** menu to open new input channel we press a button '+'. When we want to delete a channel press the button '-'. After adding the new input channel need to set appropriate parameters. Parameter **Value register** we set like in the Fig. 7.74. Next we exit from **Value register** menu.

HR 1h, b.0-15	
Register type:	HOLDING
Register number:	1h
Data format:	16 bits, signed
Data shift:	0
Data mask:	0xFFFF
<div>  </div>	

Fig. 7.74. Value register parameters

In the **Decimal point** parameter we select option: value multiplied by the **Decimal point register** (***exp(-point register)**) and in the **Decimal point register** parameter we write values as for the **Value register** of Fig. 7.74 with the change to the register number 5. Next point we set block parameters for **Channel status -HI-**. The settings of block parameters shown in the Fig. 7.75. The remaining values are left inactive (value: **never**).

Input chan.number: 1

Decimal point: * 1

Channel status '-HI-'

-HI- state: if register = value

-HI- register: HR 2h, b.0-15

-HI- value: 0x00000002

Fig. 7.75. Sample setting for the block parameters: Channel status -HI-

After configuration the **Input channels** of the device we set parameters **Register blocks**. However we exit **Input list** menu and move window over parameters called **Register blocks** and set them as follow – **Block configuration mode** we set to automatic, **Max. block size** we set to 3. **CMC-99** device automatically select the optimal list of blocks. After whole configuration exit the menu pressing **Save changes**.

Example 7.14.2: Configuration of the Modbus Output in the MASTER mode.

In this example we show how to configure the **Output channel** of SLAVE device, e.g. for TRS-10a device with **address 5**. Save data to **Register 1**, **Register 2** set to 0, **Register 5** set to 0 (mode: decimal).

In the first step we enter the **Modbus** → **SLAVE device** menu. We select by using arrows in upper navigation bar the appropriate **address** of SLAVE device (**address 5**). **Device type** parameter we set to **defined** or we can use predefined template with available settings for TRS-10a device by pressing **Load device templates** button. In this example we use first case when the SLAVE device is defined by user. Next we go to the block parameters **Device channel** and pressing the **Output list** button. In the **Output list** menu to open new output channel we press a button '+'. When we want to delete a channel press the button '-'. After adding the new output channel need to set appropriate parameters. The **Output active** parameter set to **active** - when you set **no** then the output will be defined but invisible after exit from **Modbus** menu. **Control type** parameter set to **as a linear output**. Parameter **Output register** we set like in the Fig. 7.74. Next we exit from **Output register** menu.

HR 1h, b.0-15

Register numbers: 1h

Data format: 16 bits, signed

Data mask: 0xFFFF

Data shift: 0

Fig. 7.76. Configuration Output register parameter for Modbus protocol

Similar steps we do for other output channels to **registers 2** and **5**, then exit from **Output list** menu.

After configuration the **Output channels** of the device we set parameters **Register blocks**. However we exit from **Output list** menu and move window over parameters called **Register blocks** and set **Block configuration mode** to manual. We press button **Block list**. We select by using arrows in upper navigation bar the appropriate **block number 1**. Block type we set to write HOLDING register. The **Register size** parameter we select to **16 bit registers**. In the parameter **First register** we write: 1 and in the parameter **Last register** we write: 2 (see Fig. 7.77). Next we go to the **Register block 2** and write to the first two parameters values like in the **Register block 1** however, in the parameter **First register** we write: 5 and in the **Last register** we write: 5.

After whole configuration exit the menu pressing **Save changes**.

Block number: ↓ 1 ↑

Block type: write HOLDING reg.

Register size: 16-bit registers

First register: 1h

Last register: 2h

+ - ✓

Fig. 7.77 Register blocks parameters

8. THE MODBUS PROTOCOL HANDLING

Transmission parameters: 1 start bit, 8 data bits, 1 stop bit, no parity control
 Baud rate: selectable from: 1200 to 115200 bits/second
 Transmission protocol: MODBUS RTU compatible

8.1. LIST OF REGISTERS

The device parameters and measurement result are available via RS-485 interface, as HOLDING-type registers of Modbus RTU protocol. The registers (or groups of the registers) can be read by 03h function, and wrote by 06h (single registers) or 10h (group of the registers) accordingly to Modbus RTU specification.

Register	Write	Range	Register description
20h ¹	No	0÷199	Address of device
21h	No	2060h	Device identification code
Measurements results (floating point format) ²			
200h	No	0÷0FFFFh	Measurement result for logical channel 1 (high word)
201h		0÷0FFFFh	Measurement result for logical channel 1 (low word)
202h	No	0÷0FFFFh	Status for logical channel 1: 0h - data valid, 1h - data not ready, 20h - software error, 40h - bottom border of the software measurement range is exceeded, 80h - top border of the software measurement range is exceeded, 2000h - hardware error, 4000h - bottom border of the hardware measurement range is exceeded, 8000h - top border of the hardware measurement range is exceeded, FFFFh - data not available (e.g. logical channel not configured)
203h	No	0÷6	Decimal point for logical channel 1
Register from 204h to 2F0h			Measurement results, status and decimal point for Logical Channels 2÷60
Measurements results (integer format) ²			
400h	No	0÷0FFFFh	Measurement result for logical channel 1 (high word, not considering the decimal point)
401h		0÷0FFFFh	Measurement result for logical channel 1 (low word)
402h	No	0÷0FFFFh	Status for logical channel 1: 0h - data valid, 1h - data not ready, 20h - software error, 40h - bottom border of the software measurement range is exceeded, 80h - top border of the software measurement range is exceeded, 2000h - hardware error, 4000h - bottom border of the hardware measurement range is exceeded, 8000h - top border of the hardware measurement range is exceeded, FFFFh - data not available (e.g. logical channel not configured)
403h	No	0÷6	Decimal point for logical channel 1
Register from 404h to 4F0h			Measurement results, status and decimal point for Logical Channels 2÷60

- ¹ after writing registry 20h the unit replies with the frame starting from the old (unchanged) address
- ² Float point format represents data as precision as possible. Integer 32 represents value with constant precision, selected by decimal point position. When decimal is set for example 0.0 then Int32 format represents integer part of the value contained in float registers and multiplied by 10 (e.g.: float is 1.2345, D.P. = 0.0, then Integer = 12). Similarly when decimal pint is 0.000 then integer represents integer part of the value contained in float registers and multiplied by 1000 (e.g.: float is 1.2345, D.P = 0.0, then Integer = 1234)

8.2. TRANSMISSION ERRORS HANDLING

If during reading or writing one of registries an error occurs then the unit shall return the frame containing the error code (according to the Modbus protocol).

Error codes should be interpreted as follows:

- 01h** - illegal function (only functions 03h, 06h and 10h are available),
02h - illegal register address
03h - illegal data value

8.3. EXAMPLES OF QUERY/ANSWER FRAMES

The examples concern a unit with address 1. All values are given in the hexadecimal system.

Designations:

- ADDR** Address of the device in the system
FUNC Function number
REG H,L Higher and lower part of registry number, to which the command refers to
COUNT H,L Higher and lower part of registry counter number, to which the command refers to, starting with the register, which is defined by REG (max. 32)
BYTE C Number of higher bytes in the frame
DATA H,L Higher and lower part of data word
CRC L,H Higher and lower part of CRC sum

1. Read of ID code

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	00	21	00	01	D4	00

The answer:

ADDR	FUNC	BYTE C	DATA H,L		CRC L,H	
01	03	02	20	60	A1	AC

DATA H,L - identification code (2060h)

4. Read of the registers 401h, 402h and 403h in one message (example of reading a number of registries in one frame):

ADDR	FUNC	REG H,L		COUNT H,L		CRC L,H	
01	03	04	01	00	03	55	3B

COUNT L - the count of being read registers (max. 32)

The answer:

ADDR	FUNC	BYTE C	DATA H1,L1		DATA H2,L2		DATA H3,L3		CRC L,H	
01	03	06	00	0A	00	02	00	00	18	B4

DATA H1, L1 - 401h registry (10 – high word of value for channel 1, no decimal point),
 DATA H2, L2 - 402h registry (2 – low word of value for channel 1, no decimal point),
 DATA H3, L3 - 403h registry (0 – status for channel 1).



There is no full implementation of the Modbus Protocol in the device. The functions presented above are available only.

9. APPENDIX - INPUT AND OUTPUT MODULES DESCRIPTION



All connections must be made while power supply is disconnected !

9.1. UI4, UI8, UI16, I16 - VOLTAGE AND CURENT MEASUREMENT MODULES

The UI modules are designed for easy measurement of Voltage and Current. There are 4 versions of such modules, listed below:

UI4 - 4 Voltage and 4 Current inputs

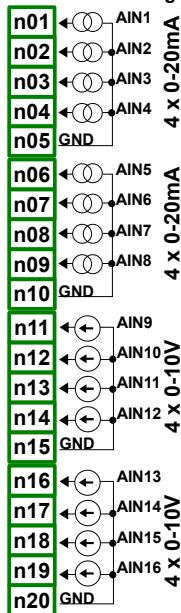
UI8 - 8 Voltage and 8 Current inputs

UI16 - 16 Voltage inputs

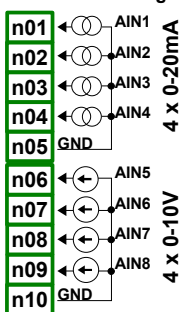
I16 - 16 Current inputs

Picture below shows terminals placement of UI modules. Inputs are gathered into groups to make connections easier. All ground terminals of a particular module are common, but separated from power supply and other modules. If it is necessary to measure Voltages with different ground potentials, several UI modules have to be installed into **CMC-99** unit.

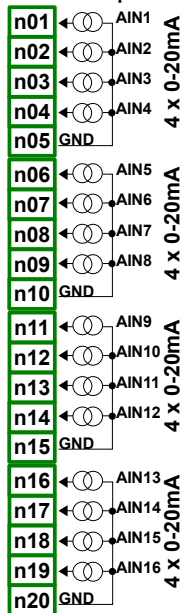
UI8
8 current + 8 voltage inputs



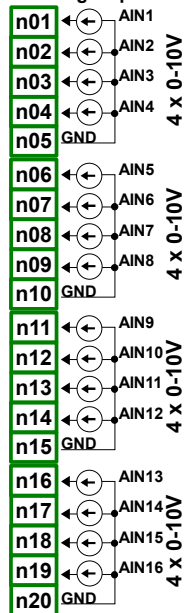
UI4
4 current + 4 voltage inputs



I16
16 current inputs



UI16
16 voltage inputs



Most important parameters of UI modules.

	UI4	UI8	UI16	I16
Number of inputs	4xU + 4xI	8xU + 8xI	16xU	16xI
Hardware measurement ranges				
voltage inputs	-2V ÷ 13V	-2V ÷ 13V	-2V ÷ 13V	-2V ÷ 13V
current inputs	-2mA ÷ 30mA	-2mA ÷ 30mA	-2mA ÷ 30mA	-2mA ÷ 30mA
Hardware resolution				
voltage inputs	1mV	1mV	1mV	-
current inputs	1µA	1µA	-	1µA
Precision				
voltage inputs	0.25%	0.25%	0.25%	-
current inputs	0.25%	0.25%	-	0.25%
Permissible Long time overload	20%	20%	20%	20%
Covered CMC-99 measurement ranges *	0÷5V, 1÷5V, 0÷10V, 2÷10V, 0÷20mA, 4÷20mA	0÷5V, 1÷5V, 0÷10V, 2÷10V, 0÷20mA, 4÷20mA	0÷5V, 1÷5V, 0÷10V, 2÷10V	0÷20mA, 4÷20mA
Internal impedance				
voltage inputs	100kΩ	100kΩ	100kΩ	-
current inputs	typ. 100Ω	typ. 100Ω	-	typ. 100Ω
Protection				
voltage inputs	no	no	no	-
current inputs	50mA fuse	50mA fuse	-	50mA fuse

- Measurement ranges are limited by software upon hardware inputs ability, check current list of **CMC-99** measurement ranges at www.simex.com.pl

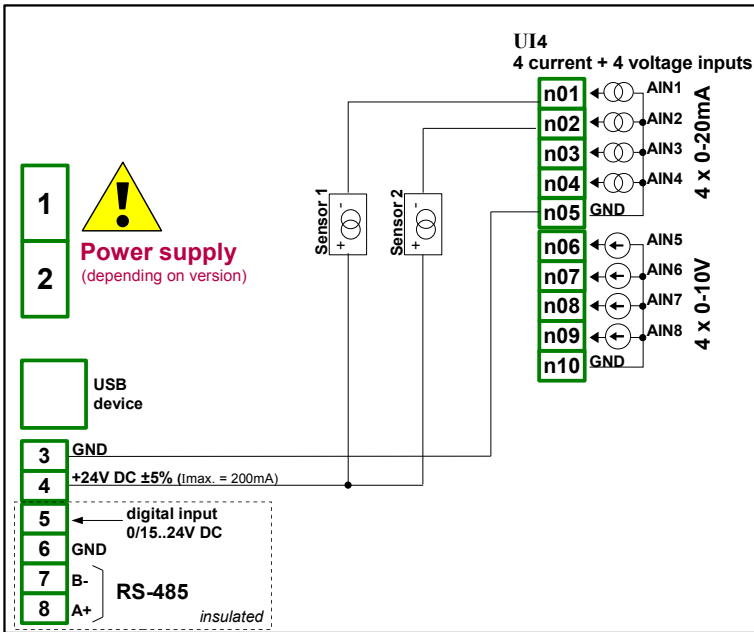


Fig. 9.1. Connections for 2 - wire sensor (current)

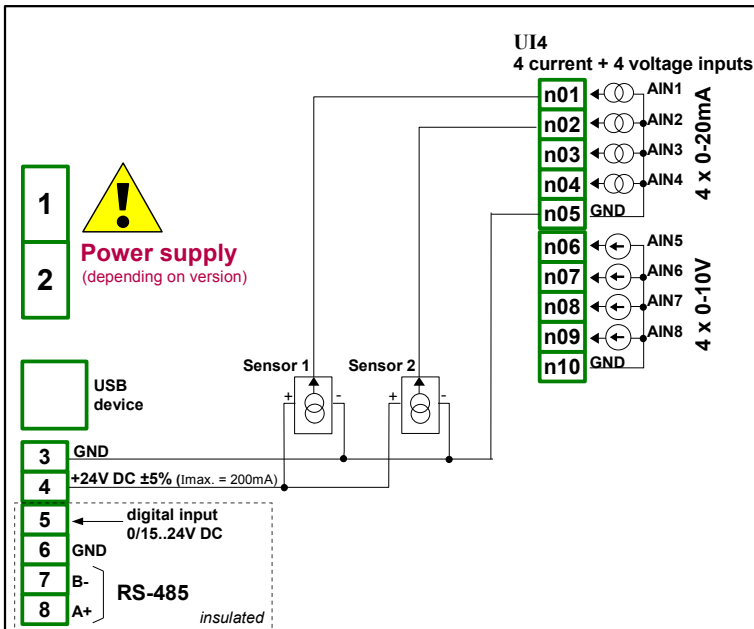


Fig. 9.2. Connections for 3 - wire sensor (current)

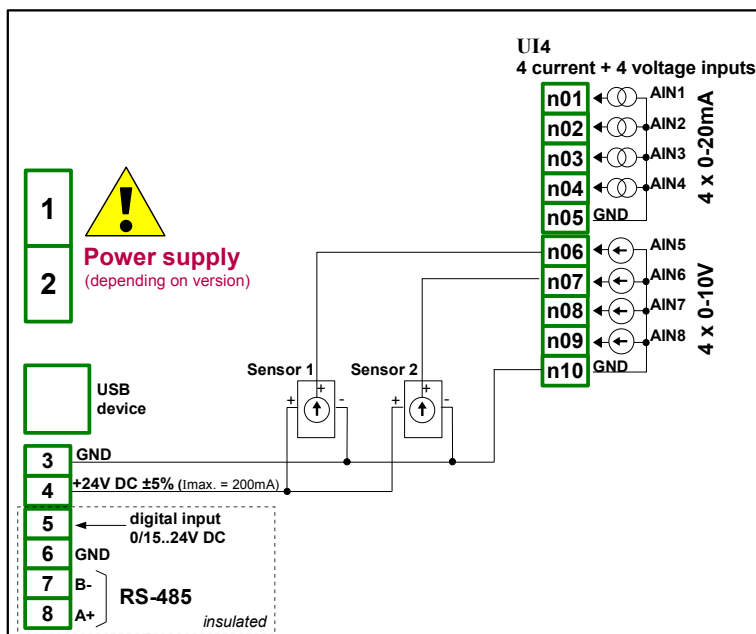
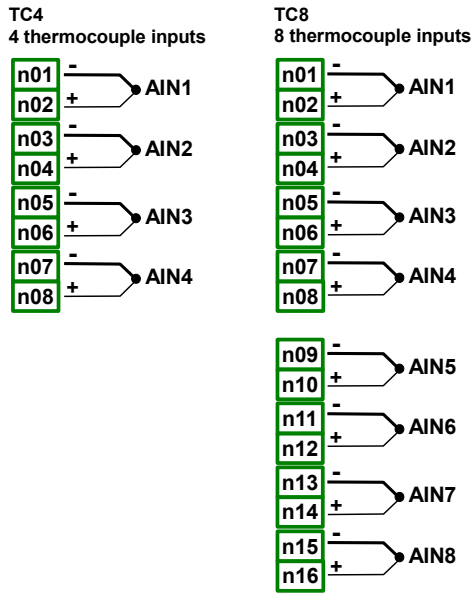


Fig. 9.3. Connections for 3 - wire sensor (voltage)

9.2. TC4, TC8 – THERMOCOUPLE SENSOR MEASUREMENT MODULES

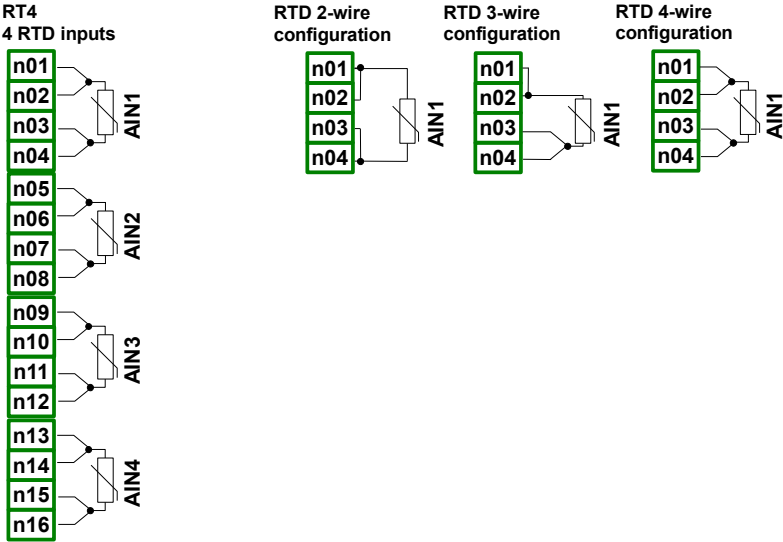


	TC4	TC8
Number of inputs	4	8
Hardware measurement ranges	-30mV ÷ 30mV -120mV ÷ 120mV	-30mV ÷ 30mV -120mV ÷ 120mV
Hardware resolution	range ± 30mV 1μV range ± 120mV 4μV	1μV 4μV
Permissible Long time overload	20%	20%
Permissible voltage difference between channels **	0.5V	0.5V
Covered CMC-99 measurement ranges *	Thermocouple: K, S, J, T, N, R, B, E Voltage: ±25mV, ±100mV	K, S, J, T, N, R, B, E ±25mV, ±100mV
Input impedance	typ. 1MΩ	typ. 1MΩ

* Measurement ranges are limited by software upon hardware inputs ability, check current list of **CMC-99** measurement ranges at www.simex.com.pl

** Hi and Lo terminals of all inputs are pulled up/down by 470kΩ resistor to internal supply/GND. It is strongly recommended not to connect Lo or Hi terminals of different inputs together, but to connect every sensor using individual wires.

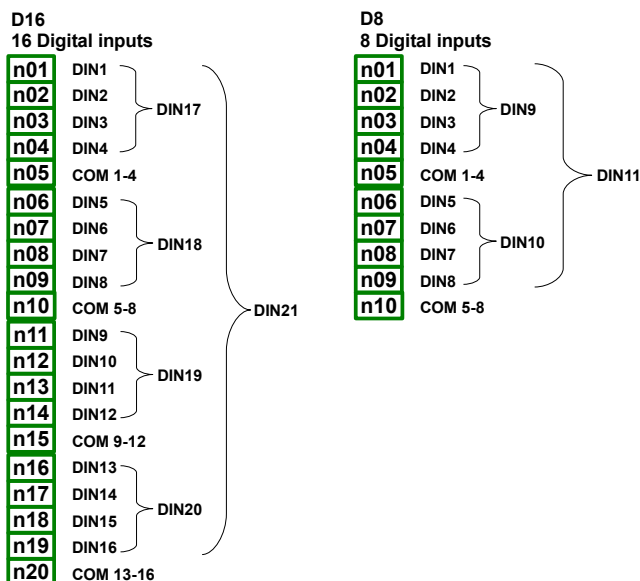
9.3. RT4 – RTD MEASUREMENT MODULE



	RT4
Number of inputs	4
Hardware measurement ranges	0÷325Ω, 0÷3250Ω
Hardware resolution	
range ±325Ω	0.01Ω
range ±3250Ω	0.1Ω
Covered CMC-99 measurement ranges *	
RTD:	PT100, PT500, PT1000
Connection method	2, 3 and 4 wire (switched manually)

- Measurement ranges are limited by software upon hardware inputs ability, check current list of **CMC-99** measurement ranges at www.simex.com.pl

9.4. D8, D16 – OPTOISOLATED DIGITAL INPUT MODULE



D8, D16 are modules with 8 and 16 digital inputs respectively. Inputs are divided into groups of four input every. Every group has own common terminal, and is optically isolated from others groups and **CMC-99** Gnd signal as well.

	D8	D16
Number of inputs	8 (2 groups 4 inputs every, optoisolated from others signals)	16 (4 groups 4 inputs every, optoisolated from others signals)
Input signals voltage levels:		
Logical LOW state	Uin < 1V	Uin < 1V
Logical HIGH state	Uin > 4V	Uin > 4V
Max input voltage	30V	30V
Input current consumption	about 15mA @24V about 5mA @10V about 2mA @5V	about 15mA @24V about 5mA @10V about 2mA @5V
Insulation strength	500V	500V
Input signals representation	8 single bits DIN1-DIN8 2 nibbles DIN9-DIN10 1 byte DIN11	16 single bits DIN1-DIN16 4 nibbles DIN17-DIN20 1 integer DIN21

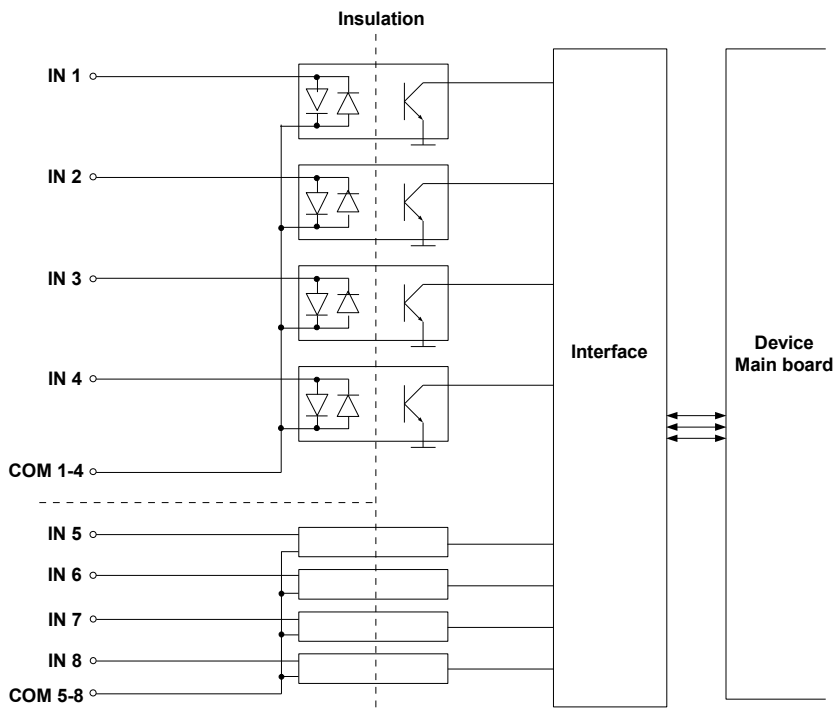
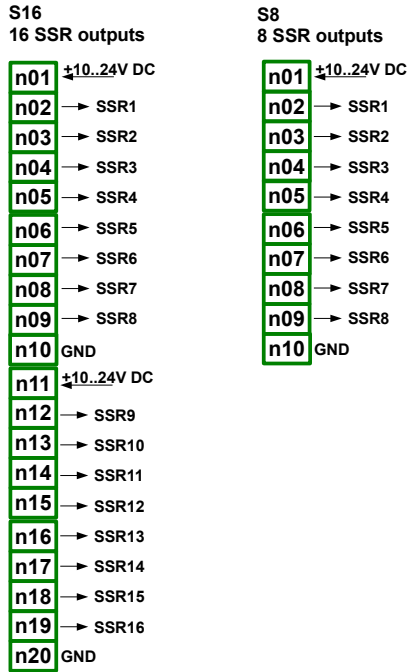


Fig. 9.4. Internal structure of the optoisolated digital input module

9.5. S8, S16 - SOLID STATE RELAY DRIVERS MODULES

	S8	S16
Static parameters		
Number of outputs	8	16 (in 2 groups with separate supply)
Max current source per output:		
while powered internally	10mA, sum limited to 50mA	10mA, sum limited to 50mA for a group
while powered externally	100mA, sum limited to 500mA	100mA, sum limited to 500mA for a group
Output High Level voltage ($I_{out} = 5mA$)		
while powered internally	$\geq 8V$	$\geq 8V$
while powered externally	$\geq (V_{ext.} - 0.5V)$	$\geq (V_{ext.} - 0.5V)$
Overload protection		
while powered internally	Internal fuse 50mA	Internal fuse 50mA (per group)
while powered externally	Internal fuse 500mA	Internal fuse 500mA (per group)
Maximum external supply of output *	30 V	30 V

Dynamic parameters (set individually for every output)

PWM period **	0.1 ÷ 1600 sec.	0.1 ÷ 1600 sec.
PWM resolution	0.1 sec.	0.1 sec.
PWM internal frequency**	5kHz	5kHz
Pulse - duty factor	0 ÷ 100%	0 ÷ 100%
Pulse - duty factor resolution	15 bits ** 0x8000 means 100%	15 bits** 0x8000 means 100%
Lo state minimum time limit	0 ÷ 800 sec.	0 ÷ 800 sec.
Hi state minimum time limit	0 ÷ 800 sec.	0 ÷ 800 sec.

* Minimum external supply voltage is 10V, if external supply is less than 10V then outputs are powered internally

** PWM internal frequency and PWM period limit Pulse - duty factor real resolution. For example, if PWM period is 0.1 sec then real resolution of Pulse - duty factor is about 9 bits ($0.1 * 5\text{kHz} = 500$ levels). If PWM period is longer than 6.55 seconds then Pulse - duty factor resolution is full 15 bits ($6.56 * 5\text{kHz} > 32768$ levels).

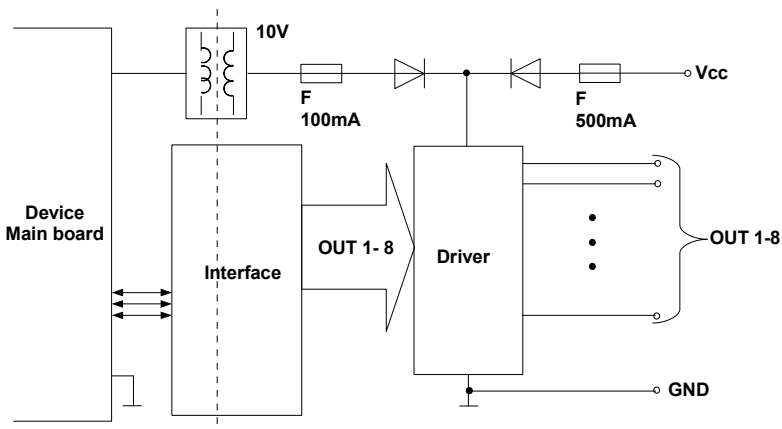


Fig. 9.5. Internal structure of the SSR output module (8 output)

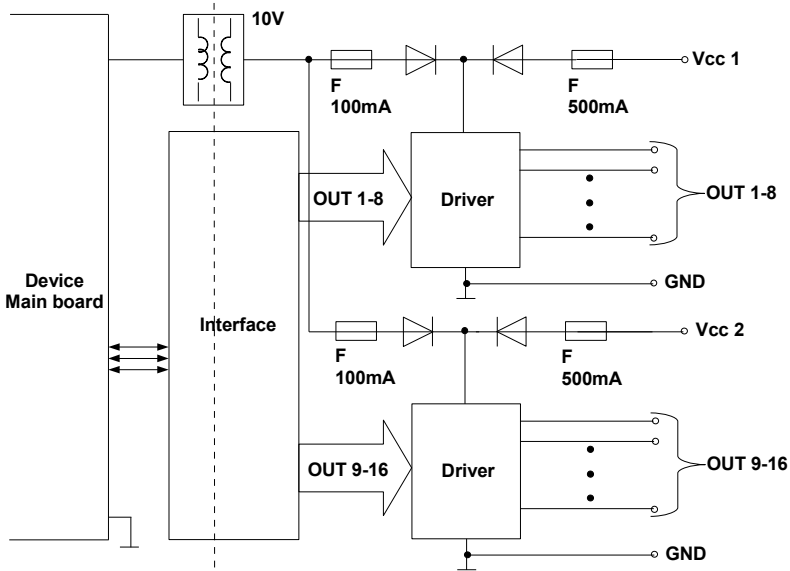
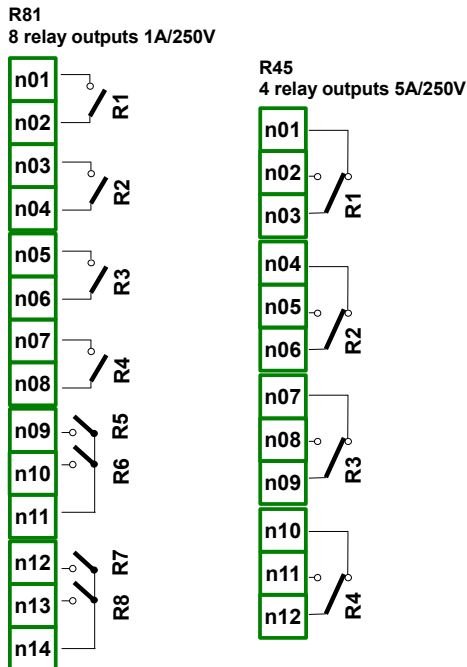


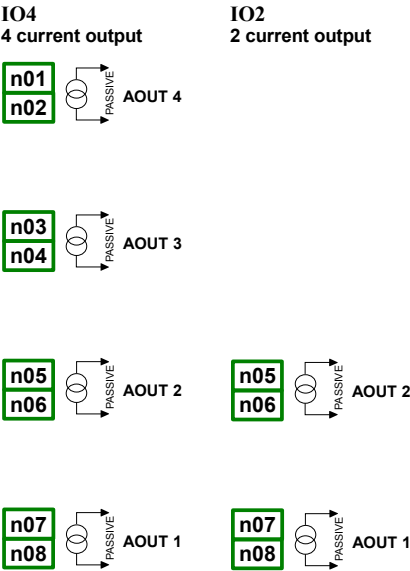
Fig. 9.6. Internal structure of the SSR output module (16 output)

9.6. R45, R81 - RELAY MODULES



	R45	R81
Number of relays	4 SPDP (Switchable)	8 SPST (N.O.)
Max. load per relay	5A, $\cos \varphi = 1$ (resistive load)	1A, $\cos \varphi = 1$ (resistive load)
Max. voltage switched by relay	250V AC	250V AC
Insulation strength (relay to relay, relay to CMC-99 supply)	$\geq 1000\text{V AC @ 60 sec.}$	$\geq 1000\text{V AC @ 60 sec.}$

9.7. IO2, IO4 – PASSIVE CURRENT OUTPUT



Technical specification:

	IO2	IO4
Number of outputs	2	4
Output type	Passive current output	Passive current output
Nominal analogue range	4-20mA	4-20mA
Hardware output limitation	3-22mA	3-22mA
Output voltage dropout	max. 9V	max. 9V
Overload protection	Internal resettable fuse 50mA	Internal resettable fuse 50mA
Loop Supply Range	9-30V	9-30V
Output current precision	0.1% @25°C, 50ppm/°C	0.1% @25°C, 50ppm/°C
Resolution	12 bit	12 bit

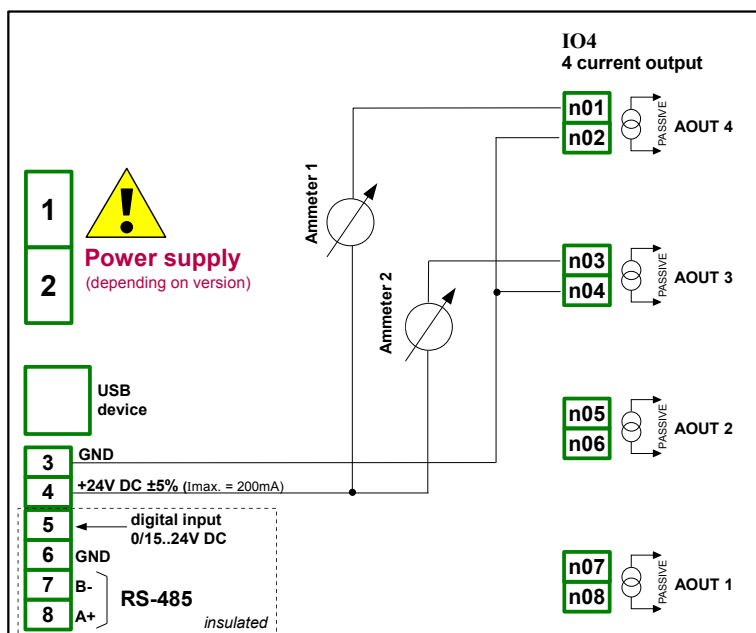


Fig. 9.7. Connections for the Passive current output



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